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SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1927



(PUBLICATION 2957)



CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION

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PREFACE

The purpose of the Smithsonian Institution as stated by its founder, James Smithson, is "the increase and diffusion of knowledge among men." The first part of this dual mission is accomplished through research and exploration; the second part through 12 series of publications. Because the research of the Institution is wholly in the field of pure science, the large majority of these publications are technical in character, being therefore of interest primarily to the student and the specialist. Besides occasional works in its regular series which prove to have a popular appeal, two Smithsonian publications are issued, however, for the definite purpose of attracting the general reader to matters of scientific interest. These are the Smithsonian Reports with their general appendixes of authoritative articles reviewing in non-technical language the yearly advance along the scientific front, and the annual Smithsonian Exploration and Field-Work pamphlets started in 1912 to inform the public of Smithsonian activities in scientific exploration. It is the hope of the Institution that this present pamphlet, covering the year 1927, will lend the reader something of the fascination of scientific field-work, and also illustrate the wide scope of Smithsonian efforts to increase knowledge.

In fairness to the Institution, it should be added that it has almost no unrestricted funds for field-work. Practically all of the expeditions sent out each year are made possible either through the help of generous friends and patrons of the Institution, or through cooperative arrangements with other scientific agencies whereby costs and collections are shared.

W. P. TRUE,
Editor, Smithsonian Institution.



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STUDYING SUN RAYS IN AFRICA, CHILE, AND CALIFORNIA

BY C. G. ABBOT,

*Secretary of the Smithsonian Institution, and Director of the
Astrophysical Observatory*

On Mount Montezuma, in the Atacama Desert of Chile, at 9,000 feet elevation, and on Table Mountain, California, at 7,500 feet, overlooking the Mojave Desert, the Smithsonian Astrophysical Observatory has two stations for measuring the intensity of sun rays on which all life depends. A third station on Mount Brukkaros, within a Hottentot reservation of South West Africa, is supported by funds of the National Geographic Society but administered by the Smithsonian. These three stations are cooperating to measure solar radiation on every possible day of the year. The observations are made and reduced in a manner to indicate the daily intensity of sun rays as they are outside our atmosphere, and to reveal any changes therein.

If one should ask: Are the sun's rays growing weaker or stronger, or are they fluctuating in a manner to produce predictable changes in weather, it would be impossible to answer because it is only recently that records of solar heat measurements have been available. Not until the Chilean observatory was founded by the Smithsonian in 1918 did daily measurements throughout the year begin. It is hoped to carry on the observations for a long term of years, so that meteorologists of the next generation can consult these basic measures, and, comparing them with climate and weather all over the world, perhaps be in position to forecast conditions with great advantage.

Within the past year, several results of promise have appeared. First, the march of the monthly mean values of solar radiation from 1918 to 1926, inclusive, shows evidence: (a) That increased solar radiation attends increased sun-spot activity; (b) that a regular periodic change of solar radiation of considerable amplitude occurs in a period of $25\frac{2}{3}$ months; (c) that less important periodicities of 15 and 11 months also appear.

Second, the observations of Dr. Pettit of Mount Wilson Observatory on the changes in the extreme ultra-violet spectrum of the sun,



FIG. 1.—The desolate Mount Brukkaros, South West Africa, where the Smithsonian operates for the National Geographic Society its solar radiation station. The dwelling in foreground, the observatory beyond on the left.



FIG. 2.—Mr. Greeley observing the sun's heat with the silver-disk pyrheliometer at the National Geographic station on Mt. Brukkaros, South West Africa.

which he finds amounting to from fifty to one hundred per cent, go closely parallel to the changes in total solar radiation of from one to three per cent observed by the Smithsonian stations.

Third, Dr. Austin of the U. S. Bureau of Standards, observing the monthly average of intensity in the receipt of radio signals from great distances, finds that these fluctuate in parallel with the changes in solar radiation.



FIG. 3.—The South West African water-boy and his charges.

Fourth, the investigations of Mr. H. H. Clayton on relations of solar change to weather continue to give indications of useful correlation.

If the periodicities of 11, 15, and $25\frac{2}{3}$ months continue to be found in future years, and to represent as now they do the major part of long range solar variation, then whatever of change in terrestrial affairs may be proved to depend on these changes in the sun will probably become predictable in general terms for many months in advance.

The Montezuma station has been in charge of Mr. Hugh B. Freeman, assisted by Mr. Eugene E. Warner. At the Table Mountain



FIG. 4.—The barren slopes of Mt. Montezuma where the Smithsonian maintains its South American solar radiation station.



FIG. 5.—Field-director Freeman reducing observations with our slide-rule machine, which saves three-fourths the computing.

station Mr. A. F. Moore, in charge, has been assisted by Mr. Harlan H. Zodtner. In South West Africa, Mr. W. H. Hoover assisted by Mr. F. A. Greeley, has established the station on Mount Brukkaros and observed beginning December, 1926, until the present with good success. Unfortunately, the sky has been less cloudless than was anticipated, but old residents claim that the year has been abnormal in that respect.



FIG. 6.—Mr. and Mrs. Freeman and Mr. Warner starting on their 12-mile journey for food and water for Montezuma station.

The following quotations from letters of Hoover and Greeley give something of the flavor of the conditions:

We have just discovered that we have some of the large lizards on Mt. Brukkaros. Our native boy killed one a few days ago which was four feet long. He said he had seen others which were very much larger. We shall try to catch one of the large ones and send the skin to you for the Smithsonian, as I understand the large lizards are rather rare now.

We have been having plenty of experience in motor travel in this country. A short time ago I was returning home with a load of provisions and just as I arrived in the middle of the Fish river (dry sand except after heavy rains) one of the axles broke. Well, the Fish river is 40 miles from Keetmanshoop

and 20 from the mountain. Our native boy was with me, so I sent a note to Fred and he telephoned to Keetmanshoop for an axle. One arrived after a day and a half. In the mean time I camped in the middle of the river. Not a place I would choose for a picnic with the temperature about 100° and a sand storm most of the day.

On the twentieth of this month, one-third of an inch of rain fell. It filled our waterhole full again, so we now have no doubts but that there will always be an adequate supply there. The rain was quite general and heavier towards the



FIG. 7.—Looking over into the Mojave desert from the Smithsonian station on Table Mountain, California.

north. The Fish river came down in flood and was between 9 and 10 feet high the first day. We drove over to the river Sunday afternoon where the road crosses between Tses and Berseba. It is a pretty spot there. After a lunch of tea and sandwiches we donned bathing suits and proceeded to treat ourselves to a swim in muddy water. We all enjoyed it thoroughly and were loath to come out after an hour of swimming about.

We hear leopards almost every night now. The Hottentot captain has promised to send out a lot of boys and dogs to catch them. The boys arm themselves with clubs, and with the aid of the dogs a leopard does not have much chance of escape.

FOSSIL FOOTPRINTS IN THE GRAND CANYON OF THE COLORADO, ARIZONA

By CHARLES W. GILMORE,

Curator, Division of Vertebrate Paleontology, U. S. National Museum

The fossil tracks of extinct four-footed animals were first discovered in the Grand Canyon of the Colorado in 1915, but the abundance of their occurrence and their great diversity of kind remained unknown until 1924. In that year and again in 1926 collections of them were made for the U. S. National Museum, and my studies of these materials have disclosed the presence of no less than 26 genera and 32 species of fossil footprints. In number of species, and in excellence of preservation of the tracks, this area easily outranks all other known American localities for Permian and Pennsylvanian footprints.

The great antiquity of these fossilized tracks of extinct creatures of a by-gone age is clearly shown by the fact that they occur from 900 to 3,800 feet below the top of the canyon wall. This means that since the first of these animals left their footprints in what was then moist sand, nearly 4,000 feet of rock-making materials were deposited in successive layers above them, not to mention the hundreds of feet more that no doubt were eroded from the present rim of the canyon. Add to this period of up-building, the length of time required for the cutting of the canyon through 4,000 feet of solid rock, and we have an idea of the tremendous age of these fossil footprints.

A third visit to the Grand Canyon under the auspices of the Grand Canyon Exhibit Committee of the National Academy of Sciences, was made in the late spring of 1927 for the dual purpose of locating and preparing exhibits of tracks *in situ*, and making further collections of fossil footprints for the U. S. National Museum. Both of these projects were successfully carried out.

Two small field exhibits, one in the Coconino, the other in the Supai formation were prepared, the purpose being to show the tracks precisely as they occur in nature in order that they may be viewed by visitors, through fixed telescopes which the committee plans to place in front of the new observation station now being erected on Yavapai Point. In order to find suitable locations for these exhibits



FIG. 8.—Slab of fossil footprints from the Hermit shale, as exposed at the head of Hermit Gorge, Grand Canyon National Park, Arizona. The following forms have been recognized: *Hylopus hermitanus* Gilmore, *Parabaropus coloradensis* (Lull) and *Collettosaurus pentadactylus* Gilmore. This slab is $6\frac{1}{2}$ feet wide and 5 feet long.



FIG. 9.—Footprint exhibit *in situ* in the Supai formation on the west side of O'Neill Butte, Grand Canyon National Park, Arizona. (Photograph by Matthes.)



FIG. 10.—Fossil trackway on large slab of Supai sandstone, quarried out in building the new Yaki trail along the east side of O'Neill Butte. (Photograph by Matthes.)

which obviously must be visible from the observing station, a considerable amount of exploratory work was necessary. As a result of this, the known geographical range of fossil tracks in the Grand Canyon was greatly extended and a considerable amount of new material was secured for the National collections. Subsequent study has shown some of the tracks to be undescribed, but the most noteworthy specimen collected, from an exhibition viewpoint, is the large slab from the Hermit formation shown in the accompanying illustration. This gives a vivid picture of the diversity of animal life that once roamed over this ancient mud flat.

An interesting development of these investigations was the discovery by Mr. G. E. Sturdevant, Park Naturalist, of a track-bearing horizon in the Bright Angel section of the Middle Cambrian. Thus four distinct ichnite horizons are established in this one geological section, distributed as follows: Coconino sandstone, 900 to 1,030 feet; Hermit, 1,350 to 1,400 feet; Supai, 1,760, to 1,800 feet; and Tapeats, 3,600 to 3,800 feet below the top of the Canyon wall.

On the south rim of the Grand Canyon, tracks have been found on Grand View Trail on the east and Dripping Springs on the west, these two localities being separated by a distance of 27 miles, and this last exploration leads to the belief that tracks can be found in the above mentioned horizons wherever the physical conditions will permit search being made for them. In view of this last statement, it is of interest to add that Mr. Sturdevant has recently discovered fossil tracks in the Coconino and Supai formations on the north rim of the canyon, some 14 miles distant in an air line from those found on the south rim.

CONTINUING THE ELEPHANT HUNT

By J. W. GIDLEY,

Assistant Curator, Division of Vertebrate Palaeontology, U. S. National Museum

Extinct elephants, the mammoths (represented by at least three species) and their near relatives, the mastodons, were native in North America throughout the entire Pleistocene Age, that geologic period which just preceded the present time, and which was marked by several epochs of widespread glaciation. During the interglacial periods and continuing even after the last great ice sheet had disappeared or at least retreated far to the north, these great beasts roamed widely over most of the United States, traveled far southward into Mexico and Central America, and extended their range northwestward into Alaska. Their fossil remains are numerous and have been found in hundreds of localities over the regions just mentioned, yet complete skeletons and even skulls are seldom found and recovered. One factor seems largely responsible for this, namely the great size of these animals. It must have been only under the most favorable conditions of accumulating deposits that entire carcasses of such very large creatures would be covered and preserved. In consequence most of the finds reported represent only a few scattered bones and more often a jaw or tooth, for teeth are less easily destroyed by the elements than other parts of the skeleton. Another contributing cause for scarcity of good material of these animals is due to the fact that many of the best preserved skeletons have been discovered in swamp-dredging, or other excavation work by men who have not had the technical training and special knowledge required to collect such material and in consequence most of these have been greatly damaged or entirely destroyed for scientific purposes. From this it may be rightly inferred that to obtain good mountable material of these ancient elephants, it is necessary to send into the collecting fields especially trained men, experienced in collecting fossil bones and properly equipped for systematic search and recovery of material discovered.

The National Museum has never been able to do this in any adequate way owing to lack of funds, but has been obliged to depend upon following up and investigating such occasional promising reports of finds as come to the Museum from time to time, and as small allotments are found available.

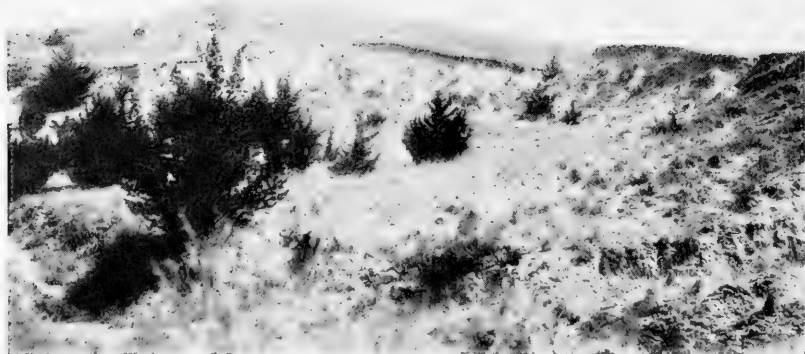


FIG. 11.—Sedimentary deposits of Pleistocene Age. Typically eroded exposure near top of plains a few miles northwest of Curtis, Oklahoma.

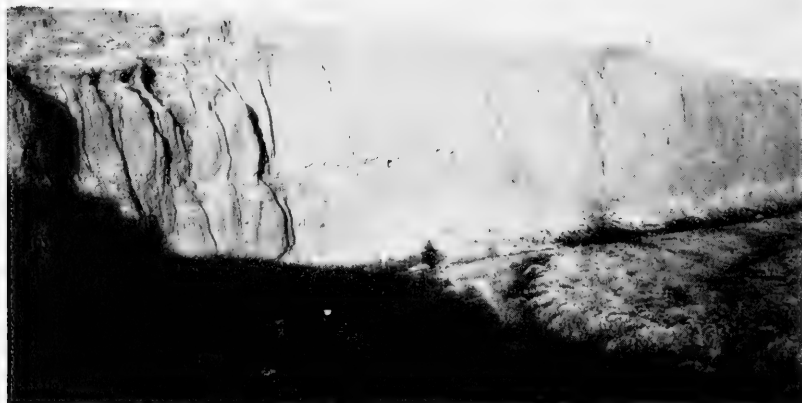


FIG. 12.—Cut-bank of Pleistocene and recent deposits in valley fill about 60 miles west of Alva, Oklahoma. Bones of mammoth were found at base of bank.



FIG. 13.—Hill of stratified Pleistocene stream-deposits resting on red-beds of Triassic Age. About $2\frac{1}{2}$ miles northnorthwest of Curtis, Oklahoma. On the slope of this hill were found teeth of an extinct species of horse, and a large section of a tusk of the mammoth.



FIG. 14.—Opposite side of hill shown in figure 11. A few mammoth bones were found here. A palate of a skull with both cheek-teeth in place are being uncovered at spot marked by whisk-broom.

In this way the Museum has procured in years gone by three good skeletons of mastodons, one a rare and unique species; but as yet no skeleton of the mammoth suitable for mounting has been secured, although several reports of mammoth bones which have turned out to be of some value have been investigated. A short account of one of these was published in last year's *Explorations and Field-Work of the Smithsonian Institution*.¹

More recently two additional favorable reports of such discoveries came to the Museum, one from Curtis, a small town in northwestern Oklahoma, the other from Sarasota, Florida. I was detailed to investigate these finds and near the end of March left Washington for this purpose going first to Oklahoma and afterward to Florida. The Oklahoma find was reported by Mr. B. C. Baxter, a resident and proprietor of a newspaper in the little town of Curtis. This gentleman met me on my arrival on March 31st and took me at once to the locality at the head of a little canyon about two and one-half miles north-northeast of the town where investigation was at once begun. This was followed by several days search here and exploration of the surrounding country. It seems not out of place to express here my appreciation of Mr. Baxter's public spirited attitude in the matter, first in reporting his discoveries to the National Museum, and afterward in rendering what assistance he could in furthering the work of investigation and exploration during my stay at Curtis.

The prospect at the canyon head just mentioned looked promising but on investigation proved disappointing. Many fossil bone fragments were scattered along the exposures, but a little digging soon revealed the fact that there was small hope of securing anything like a complete skeleton here, as it was quite evident the fossil-bearing beds, which are of Pleistocene Age, represent rather slowly accumulated river channel deposits and the contained bones had been much broken and scattered before their original burial in the sand and clay layers of which the beds are composed. However, a good palate portion of a mammoth skull containing the cheek teeth, some important foot bones, ribs, vertebrae, and also a few teeth of an extinct species of horse, probably *Equus scotti*, were collected. At another locality, two or three miles southeast, were later found a jaw and other bones of a rare species of ground sloth belonging to the group known as *Nothrotherium*, apparently representing a newly discovered species of this genus.

¹ Smithsonian Misc. Coll., Vol. 78, No. 7, pp. 48-51.



FIG. 15.—A reminder of the great Mississippi flood taken from the rear end of Pullman as train was nearing the Arkansas end of the bridge which spans the river at Memphis, Tennessee.



FIG. 16.—A tributary of Peace River near Zolfo Springs, Florida. Fossil bones of Pleistocene Age, including a tooth of the mammoth were picked up on spot where men are standing.

In my exploration by automobile, of many miles of the surrounding country. I found abundant evidence that there are many isolated areas, usually of limited extent, of fossil-bearing Pleistocene deposits in that general region. These seem to be remnants of ancient stream channels which once occupied the high plains country before the present valleys were formed and the present drainage systems established. While none of the exposures examined yielded much of value they gave promise of good returns had time and funds permitted a much more extended exploration.

Leaving western Oklahoma April 11, I arrived in Sarasota, Florida, on the morning of April 13. Here I was met by Mr. J. E. Moore, the



FIG. 17.—Drain ditch in north city limits of Sarasota, Florida. Mr. Moore, of Sarasota, is pointing to spot in the bottom of the ditch where several fossil-horse teeth were recovered.

discoverer of the fossil bones in the vicinity of Sarasota, and received from him the same cordial and helpful assistance I had had from Mr. Baxter in Oklahoma. Things looked promising here also, but, as in Oklahoma, I was destined to be again disappointed in my search for the "big prize," namely, a mountable skeleton of the mammoth. Also, as in Oklahoma, the visit to this locality was not unproductive, as, in the few days of my stay in Florida, from the several localities we visited in this vicinity and in the neighborhood of Zolfo Springs, about 60 miles east of Sarasota, I recovered a respectable little collection of fossil bones and teeth, including remains of the mammoth, mastodon, extinct horse, bison, camel, tapir and other smaller kinds of prehistoric mammals, all from Pleistocene deposits.

CAMBRIAN GEOLOGY OF THE ROCKY MOUNTAINS

By CHARLES E. RESSER,

*Associate Curator, Division of Stratigraphic Paleontology,
U. S. National Museum*

For a number of years I have been carrying on field-work, both in the western United States and in Europe, under the direction of Dr. Charles D. Walcott, to obtain data to be used in systematizing the Cambrian System and more particularly to find a Middle Cambrian section complete enough to serve as a standard of reference for these strata in other parts of the world. Owing to the lamented death of Dr. Walcott in February, 1927, it became necessary for me to interrupt this program and visit a wider area this past summer than would otherwise have been done.

Dr. Walcott was occupied during the last few years of his life in summarizing the knowledge gained in the extensive researches conducted throughout his long and fruitful career, with the result that at his death he left a large uncompleted manuscript presenting a comprehensive treatment of the stratigraphy in the Canadian Rocky Mountains where he made many remarkable discoveries. As I was detailed to edit and attempt to complete this manuscript, it became necessary to reexamine certain Canadian sections for stratigraphic details which were found lacking when Dr. Walcott assembled his data and which he had hoped to seek in the field himself.

Since the motor truck used in previous years had been sold as no longer useful for strenuous field-work, a new one was purchased in Washington, through the generous assistance of Mrs. C. D. Walcott, and driven across the continent. Our party traveled by this means from the time of leaving Washington until the outfit was stored at Salt Lake City, a total of more than 6,000 miles, traversing a considerable portion of the continent. It was a pleasure to find that Dr. R. S. Bassler, curator of stratigraphic paleontology, U. S. National Museum, was willing to accompany me, and so I have had the benefit of his advice and experience in stratigraphic geology, thus assuring more certain results in the field determinations. My son, Harold Resser, served as camp assistant.



FIG. 18.—Dr. Bassler entertaining a bear in the Yellowstone Park forest.
(Photograph by Resser.)



FIG. 19.—Vermilion Pass Camp among the tall conifers on the Continental Divide. Mt. Whymper in the background exposes a fine Cambrian section.
(Photograph by Resser.)

We left Washington on July 21 and met Dr. Bassler in Provo, Utah, July 29, having covered the 2,250 miles in eight days, one of which was spent in a repair shop, a delay made necessary by a plainsman, fearful of the outer edge of a winding mountain road, coming up on the wrong side of the road. No other means of transportation than by motor can give one such an intimate view of our country nor so impress on the mind its immensity and the extent of its resources.

After securing the portion of the camp outfit that had been left in storage at Provo, we moved on to Salt Lake City where a conference with the local geologists was held concerning their more recent discoveries and advice as to desirable places to visit was obtained. Here Dr. Bassler was able to arrange for an important collection of Permian fossils, which has since been received at the Museum.

After briefly studying the Wasatch Mountains and traversing Yellowstone Park, the sections in the mountains immediately to the north were examined, the one along Newland Creek, Meagher County, Montana, being studied in some detail. Then since our route led by the Little Belt Mountains, stops were made here to study their Cambrian strata.

The main objective of the summer's work was the general region of the Bow Valley, Canadian Rocky Mountains, to the north and west of Banff, Alberta. The first camp was made on Vermilion Pass on the Banff-Windermere road, in which vicinity a number of sections were studied. It was hoped that as a side issue of the season's work the vexing question as to the exact stratigraphic boundary between the Lower and Middle Cambrian could be determined, and here in Vermilion Pass there seemed to be a chance for finding the necessary data. However, the time and equipment at our disposal did not permit us to reach a sufficient number of points to enable us to decide the question. A survey of the interesting and important section in the Sawback Range was next made with the idea of verifying the presence of certain Cambrian and Ozarkian formations.

Several days were spent in the vicinity of Lake Louise where many of the best Cambrian sections are located. Camp was then moved into the Kicking Horse Canyon near Field, where are located two remarkable fossil localities: one on Mt. Stephen, which has been known for more than 50 years; and the other above Burgess Pass, where Dr. Walcott discovered the most important Cambrian fauna ever found. We continued down the Kicking Horse River to Golden, reviewing the great sections exposed along the gorge of that river.

In the Columbia River valley we had the good fortune to be accompanied by Dr. Charles S. Evans of the Canadian Geological Survey, who by his assistance saved us much time, particularly in the Sinclair Canyon section. Continuing up the Columbia valley to its head, then again into the Kootenay drainage, we had the pleasure of discovering a new locality for some very important Lower Cambrian beds near Fort Steele, British Columbia.

Returning now to the United States, and with the main stratigraphic work completed, Dr. Bassler left the party at Coeur d'Alene,



FIG. 20.—Cliff of Upper Cambrian beds in Newland Creek Canyon, Montana, with camp in the foreground. All the strata from the Pre-Cambrian to the Carboniferous dip uniformly to the west. (Photograph by Resser.)

Idaho. He continued to the West Coast where, before returning to Washington, he spent a few days studying the geology of the Coast Range from which he has previously described several faunas. My son and I then traveled eastward across the picturesque Bitterroot Mountains, through the extensive mining district of Idaho, a region always interesting to the geologist. A brief stop was made at Logan, Montana, where the accumulated fossils were packed and shipped. Following this, visits were made to outcrops of interest in the mountains of the south, on the way back to Salt Lake City, where the truck and camp outfit were stored at the University of Utah, through the kindness of members of the Department of Geology.

THE MINERALS OF MEXICO

By W. F. FOSHAG,

*Assistant Curator, Division of Mineralogy and Petrology,
U. S. National Museum*

Although Mexico is one of the richest countries in the world in mineral resources, but few collections of its minerals have been made and comparatively little is known of the mineralogy and geology of Mexico. In 1926 a start was made towards assembling a representative collection for the U. S. National Museum, and this year, in continuation of the work, I visited a number of localities in the States of Sonora, Chihuahua, Durango, Zacatecas and Guanajuato.

Las Chispas mine, near Arispe, Sonora, is well known for the richness of its silver ore and the beauty and great size of the various silver minerals found there. It was with the hope of acquiring a complete series of these specimens that I first proceeded to Arispe. The rich ore bodies are comparatively small pockets lined with large crystals of stephanite, polybasite, argentite and pyrrargyrite and it is from these pockets that the remarkable specimens come. A small series, not so extensive as had been hoped for, yet a very valuable addition to our collections, was obtained. As incidental to this part of the field-work, I studied some rocks in the vicinity of Arispe and made some collections at Cananea, Sonora and Bisbee, Arizona.

From Sonora, I went to El Paso where I was joined by Mr. Harry Berman, of the Mineralogical Museum of Harvard University, who acted as assistant throughout the rest of the field season. After a few days in Mexico City, where the Hon. Sr. Genaro Estrada, Acting Secretary of Foreign Relations, graciously received us and extended the necessary permission for investigation and collection, we proceeded to Guanajuato in the state of the same name. The famous Veta Madre of Guanajuato upon which mining first began in 1558, has probably been the richest silver-gold vein of the entire world. The production of the district, mainly from this one vein, has reached the enormous total of \$1,000,000,000, and it is still producing about 1,000 tons of ore per day. The rich bonanza ores of the early days now appear to be entirely exhausted, but mining is made profitable by the efficient treatment of large bodies of low grade ore. The Veta



FIG. 21.—Typical valley and mountain range of the Plateau region of Mexico. Yuccas and creosote bush on the hill-slope. (Photograph by Foshag.)



FIG. 22.—The "Bufo" of Mapimi. A typical mountain range of central Mexico. Cretaceous limestone sloping gently to the south. (Photograph by Foshag.)

Madre occupies a well defined fault with schists as the foot, and conglomerates as the hanging wall.

From Guanajuato we went to Zacatecas, another of Mexico's famous camps. Several large veins are found in the district, the most conspicuous being the Cantera vein prominently visible from the center of the city. This vein can be easily followed to the south for a distance of 15 kilometers or more. The geology of this district is very similar to that of Guanajuato. Mining has almost ceased in Zacatecas, presumably due to the exhaustion of the bodies of commercial ore but a number of smaller camps in the vicinity have promise. We visited one such district, Ojo Caliente, where the Bilbao Mine attracted our attention because of the abundance here of the chloro-arsenate of lead, mimetite, and the report that other rare minerals were obtainable in quantity. Unfortunately the low price of lead necessitated the closing of the mine a few weeks before we arrived, and the exceptional material known to be still in the mine was unobtainable.

Reported new finds of fine specimens at the Ojuela Mine, visited during the field-work of last year, brought us there. I was able to study somewhat more in detail some of the more interesting features of this important deposit of lead and silver and was able to collect, together with pyromorphite and other rare and beautiful minerals, a number of good specimens of the very rare species, carminite, an arsenate of lead and iron.

While in Mexico City we had the good fortune to arrange with the officials of the Penoles Company for permission to visit Naica, in the State of Chihuahua, and take out of the famous gypsum cave of the Maravilla Mine two groups of the enormous crystals that are found there. The group selected for the Museum's exhibit consists of 15 crystals, the smallest three feet, and the longest five feet in length. The entire group measures ten feet in length, and will be used to reconstruct a section of this unique cave. The two taken out are the finest examples of large crystal groups in any Museum in the world. Some smaller but very fine groups of clear gypsum were also procured.

Our next stop was at the old and famous camp of Santa Eulalia where we were able by rare good luck to collect at the Potosi Mine some unique specimens of pyrrhotite, a sulphide of iron. Single complete individuals, two inches across and an inch thick, as well as unusual matrix specimens, are believed to be unparalleled. The ore



FIG. 24.—Street in Zacatecas, Mexico.

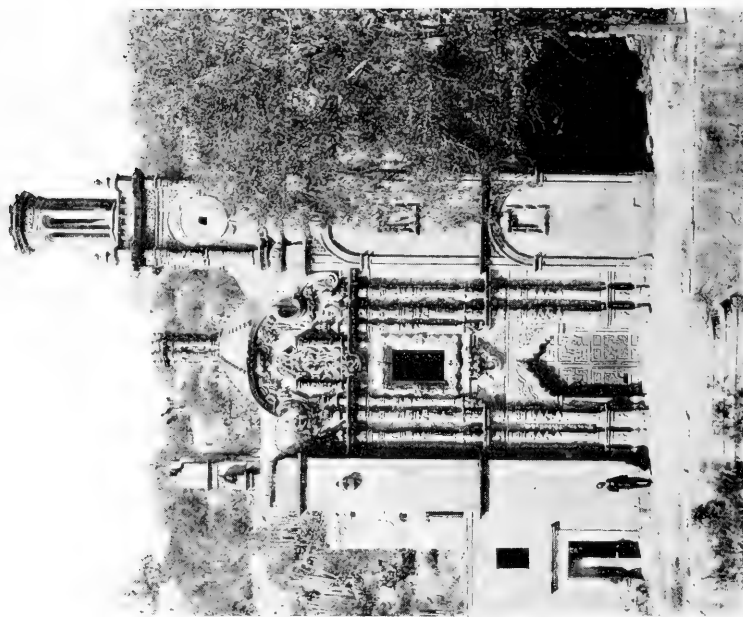


FIG. 23.—Church of the mine of San Miguel de Rayas, Guanajuato, Mexico. The walls at the summit of the hill in the background inclose the Patio of the famous Rayas Mine. (Photograph by Foshag.)



FIG. 25.—Guanajuato, Mexico. The mines of Guanajuato have produced over one billion dollars in gold and silver.



FIG. 26.—Street in Guanajuato, Mexico. Burros laden with alfalfa.
(Photograph by Foshag.)

bodies of Santa Eulalia, aside from their great economic importance are of unusual geological interest. They are in the form of huge chimneys that cut across beds of limestone. From these chimneys lateral extensions called *mantos* extend for variable distances horizontally. One such *manto* which we examined in the Mina Vieja Mine had been followed for two miles from its source and had been in continuous ore.

Our last work was done at Los Lamentos revisiting the Ahumada Mine. The ore body of this mine consists of a continuous *manto* that follows the contact between a fine-grained blue limestone and a highly fossiliferous pink to light gray one, and is characterized by an aureole of dolomitized limestone about it. Beautiful specimens of various lead minerals, wulfenite, vanadinite and descloizite are often abundant at the Ahumada Mine and make very desirable display specimens. Some choice material was collected and the study of the deposit considerably extended.

The field-work in Sonora was undertaken with money from the Roebling Fund. Later work was in collaboration with the Mineralogical Museum of Harvard University. For the successful field-work I am indebted to a number of the mining men of Mexico, without whose active cooperation little could have been accomplished.

GEOLOGICAL EXPLORATIONS IN MICHIGAN

By ERWIN R. POHL,

Aid, Division of Stratigraphic Paleontology, U. S. National Museum

Under an arrangement existing between the U. S. National Museum and the Milwaukee Public Museum an expedition, represented by myself for the Museum and by Mr. Gilbert Raasch, Assistant Curator of Geology of the Milwaukee Museum, was formed with the purpose of continuing the detailed study of the little-known but highly important stratigraphy of the Middle Paleozoic of the mid-eastern and central United States. In the two previous years the work had been carried as far west as the Ontario peninsula. In pursuance of the general outline this year's itinerary took us through the northern central basin province.

The collections of the National Museum already contained much excellent material from many of the Michigan localities; but the disconnected data, brought together over a period of a half century by a score of collectors interested primarily in the quality of their specimens, was insufficient to a clear understanding of the geologic history of the region. It was hoped that the results of this explorative work would not only throw light on the gaps in the sequence but also establish tie-points with beds of similar age in neighboring areas.

The area covered by eastern Wisconsin, southern peninsular Michigan, and southwestern Ontario is in the region of the ground moraine of the Great Glacier. Most of the topographic features of this country are thus due to glacial phenomena and only in certain portions of it is the bed-rock exposed. Such patches, due to subsequent denudation, are to be seen in the vicinity of Milwaukee, in a narrow band near the northern edge of southern Michigan, and near the shores of Lake Huron in Ontario. From the fossils contained in the outcrops of these beds it has long been known that the period of deposition was during Middle Devonian times; but the actual interrelations among themselves and their positions in the type section of this age, as it is evidenced in New York State, has formerly remained undetermined.



FIG. 27.—A typical exposure of bed-rock on the western Michigan shore. Little Traverse Bay, Michigan. Because of the local structure the geologist has only to follow the shore-line to determine the entire sequence. (Photograph by E. R. Pohl.)



FIG. 28.—An outcrop of Mississippian black shale on the shores of Lake Michigan near Norwood, Mich. By comparison with Fig. 51 of *Smithsonian Explorations and Field-Work in 1926* the similarity of these beds with those of Ontario can be seen although 300 miles separate the localities. (Photograph by E. R. Pohl.)

Our party remained at Milwaukee for a week collecting material and data in the Lake Church and Milwaukee quarries before proceeding into Michigan. Here a camp was established at Charlevoix, from which were explored all localities known to the Michigan Survey and many new ones. Owing to the fact that the geology was complicated by local structure and limited exposures, camp was not moved for two weeks. On completion of the work in the vicinity of Little Traverse Bay, the outcrops were traced across the belt to the eastern shore of Michigan. Much of the country is swampy and undeveloped, and traveling is difficult away from the beaten paths of the tourists. From an industrial standpoint the northern belt of Michigan is highly interesting, for it contains several of the largest limestone quarries in the world (fig. 29). Much of the rock is dolomitized and it is impossible to produce the fine grades of cement which we find in the New York Portland works; but a good deal of the material is converted for alkali uses. This entire area is a collector's paradise, for nearly every bed in the section is crowded with excellently preserved fossils in great variety (fig. 30). Fossils are perhaps better known to the layman in this region than in most districts of the United States, for the gravel of the bathing beaches and the shores of Little Traverse Bay (figs. 27 and 28) are composed of water-worn pebbles of fossil corals and shells, locally called "Petoskey Stones."

A visit to Silica, Ohio, to obtain a collection of what are probably the finest preserved Devonian fossils ever found, led to a meeting with Dr. J. E. Carman, of Ohio State University. As this fossil fauna has been Dr. Carman's special province of research, a day of collecting and study was very profitably spent with him here.

On the trip through Ontario to Limestone Mountain, Mich., additional data and collections relating to the Ordovician, Silurian, and Lower Devonian were assembled. Limestone Mountain (fig. 31), near Baraga at the southern end of the Keweenaw Peninsula, is an erosional remnant or monadnock, forming an isolated reminder that this area was below sea level during much of Lower and Middle Paleozoic times.

Up to within the present decade it was believed by the majority of geological students that the interior of our continent was a region of vast seas which existed with but little change over long lapses of time. Such an inland sea, stretching from eastern New York to Iowa and Missouri, and from Kentucky to northern Michigan, was



FIG. 29.—Part of one of the many enormous limestone quarries in the northern belt of southern Michigan. All equipment is electrified. In the foreground is a log barricade for the protection of quarrymen during the noonday blasting. (Photograph by E. R. Pohl.)



FIG. 30.—Where fossils are legion. A blue shale has been thrown out of the test pit in the foreground and in weathering has exhibited thousands of fine shells. Quarry near Charlevoix, Mich. (Photograph by E. R. Pohl.)



FIG. 31.—Limestone Mountain, near Baraga, Mich. This isolated erosional remnant is the only tangible proof that parts of the northern peninsula of Michigan were basins of marine deposition during most of Paleozoic time. (Photograph by E. R. Pohl.)



FIG. 32.—A quarry face illustrating one of the most interesting features of stratigraphy. The black line through the center of the picture draws the boundaries of two formations and shows surface erosion of the one and overlap by the other. Such a contact is called an unconformity. Near Petoskey, Mich. (Photograph by E. R. Pohl.)

hypothecated for the period of Hamilton deposition. The shore line, it was admitted, was irregular and a narrow strait through which there was supposed to be a mingling of the faunas of the eastern and western arms of the immense sea was thought to have existed where the state boundaries now define Wisconsin and Michigan. Dr. E. O. Ulrich of the U. S. Geological Survey was the first to point out that it was only in exceptional cases that such conditions prevailed, and now, through the present detailed study, it is definitely known that the actual conditions of deposition were quite different. It is still questionable as to just where the Wisconsin Devonian strata belong in the general geological column; but stratigraphic observations have established the fact that the entire Michigan section lies below that of Ontario while the Ontario strata belong in a position below the middle of the typical Hamilton series of New York State.

Nearly two tons of selected specimens of beautifully preserved and finely sculptured fossil shells and corals were shipped to the Museum. These, together with the collections already in the Museum's possession, form as nearly a perfect series of fossils from these beds as can be brought together.

ZOOLOGICAL EXPLORATION IN HISPANIOLA

BY ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution

The island that Columbus named Hispaniola, divided politically between the Dominican Republic and the Republic of Haiti, offers, in its zoological features, one of the most interesting areas for study in the West Indies. To supplement the collections previously made for the National Museum in Hispaniola by Dr. W. L. Abbott, and to obtain information on faunal areas and distribution for use in reports now in preparation on the Abbott collections, I conducted zoological explorations on the island, under the Swales Fund, from March 27 to June 3, 1927.

Following my arrival in Port au Prince, and a few days spent in that vicinity, work was begun at Fonds-des-Nègres in the southern peninsula where, in company with Dr. C. H. Arndt, a considerable area was covered, from Aquin on the south coast to the great fresh water lake known as the Etang de Miragoane on the north. Much of Haiti is dry and arid, but the vegetation in the better watered region at Fonds-des-Nègres appears more as is anticipated in visits to subtropical regions. Guinea hens running wild in abundance, native coots with smooth, glistening white plates on the forehead, gray or green lizards 12 inches in length clinging motionless on the tree trunks, and for some unknown reason held in the deepest fear by the Haitian laborers, were a very few of the many attractive features of this locality. It was here that I had opportunity to investigate the communal nests of the palm chat, a bird peculiar to the island. The palm chats are as large as bluebirds, and are of gregarious habit, being found in little bands that construct at the top of some royal palm a permanent home of sticks, a structure at times six or seven feet in diameter.

On returning from the southern peninsula, we set out one morning from Pétionville, a village in the hills back of the capital city, for the great mountain ridge of La Selle. Our road, at first broad and open, wound steadily up the slopes of the hills bordering the Cul-de-Sac plain toward Kenscoff and Furcy to altitudes where the air was cool and pleasant, although we looked far down into the shimmering heat



FIG. 33.—Aquin Bay, Haiti, on the southern shore of the southwestern peninsula. Taken April 3, 1927.



FIG. 34.—Camp among the pines on the Massif de la Selle. Heavy rains fell daily, necessitating a shelter. Taken April 12, 1927.



FIG. 35.—Native cane mill at the Artibonite River near Las Cahobes, Haiti, on the road to Hinche. The juice of the cane, expressed by heavy wooden rollers, is boiled over open fires in the shed in the background to make rapadou or crude sugar. Taken April 20, 1927.



FIG. 36.—Looking across the central plain of Haiti near Hinche. Annual fires burn off the prairies so that the peculiar plants and animals are confined to ravines cut below the general level. Taken April 23, 1927.

of the broad plain. Along our trail appeared the familiar weeds of temperate climates, left as evidence of the agriculture of the period of French colonization. On the second day of this journey, when we approached the precipitous escarpment of La Selle itself, our pack animals were unable to progress with their loads of camp and collecting equipment over the steep, rocky trails, and we engaged cheerful Haitian women as porters, finally reaching the summit of the ridge at 7,500 feet above the sea. At camp a thousand feet below the summit near the head of the Rivière Chotard, forests of pine extended on either hand, while the ground below was covered with bracken or a turf in which white clover and strawberries blossomed. The higher peaks and many ravines were covered with a rain-forest jungle in which trees and shrubs grew densely, interlaced with the entangling, wirelike strands of a creeping bamboo. Parrots, vociferous crows, and pigeons were abundant in the pinelands, while in the jungles were found solitaires, a beautiful chestnut-sided robin not previously known to science, and many other birds. In early morning, it was pleasant to rest in the warm sun on the edge of the 1,500-foot precipice that marked the face of Morne La Visite, one of the higher points above camp, while through the still air from the jungle depths came the clear, flutelike notes of the *musicien*, the appropriate Haitian name of the solitaire, mingled with the barbaric beat of distant work drums to whose irregular cadence laborers toiled and sang in a remote world of cultivated fields far below. As no zoological collector had visited this mountain ridge so far as known, many specimens taken were new to science. Smoothly scaled lizards, found under flat stones and preserved on the spot in a bottle of native rum purchased from the load borne on the head of a traveling merchant woman, proved to be a new genus, and landshells gathered at random were also new. By means of a tall pine tree felled for a ladder, we climbed down into a great sink hole and discovered in a sheltered crevice bones of extinct mammals that ranged the island before the coming of Columbus.

Returning to the lowlands, I journeyed to Hinche in the level, central plain where I was welcomed at the experiment station by Mr. J. E. Boog-Scott, and pleasantly entertained while I explored for strange birds. One journey was made as far as the caves at l'Atalaye, where we viewed the excavations from which had come the remains of a giant owl and numbers of other creatures that have become extinct for no apparent reason and are known only from their skeletons in these deposits.



FIG. 37.—In the delta of the Río Yuna near Samaná Bay, Dominican Republic. Taken May 10, 1927.

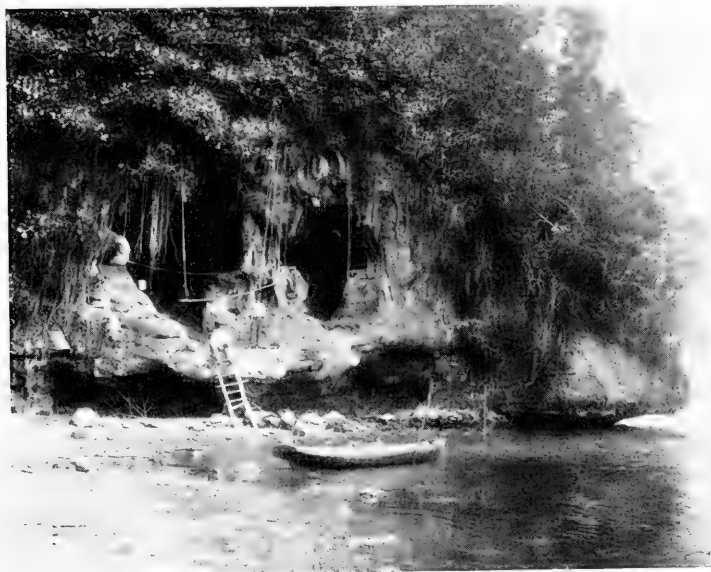


FIG. 38.—One of the many caves at San Lorenzo Bay, formerly the home of Indians. Taken May 11, 1927.



FIG. 39.—A country home at El Río, Dominican Republic, on the mountain trail to the Valley of Constanza. Taken May 29, 1927.



FIG. 40.—Adjusting pack panniers on the trail leading to Constanza. The sturdy mules carry heavy burdens without seeming difficulty. Taken May 20, 1927.

The last journey in Haiti was by airplane from Port au Prince to the north over the central plain, past the ruins of the Citadelle of Christophe perched on its high hill top, to Cap Haïtien, and then overland by auto to Poste Charbert where were many things of interest. On the return we crossed to Gonaïves and for miles flew low over the coastal swamps viewing the myriads of water birds disturbed by our near passage, finally locating the flamingos of which we were in search. As they rose in flight, while the plane banked above them,



FIG. 41.—The mountain village of Constanza, Dominican Republic. The writer occupied the white-washed structure in the foreground. The Valley of Constanza is said to have been settled in 1750. Taken May 23, 1927.

I examined them quickly one by one to enjoy their beautiful colors to the fullest extent, to find at the end of the flock, a little separated, three roseate spoonbills, the clean pink of their plumage vying in tint with that of the flamingos.

Throughout the period of work in Haiti the friendly cooperation of General J. H. Russell, American High Commissioner, and Dr. George F. Freeman, Directeur Général of the Service Technique du Departement de l'Agriculture, was of the greatest assistance.

In Santo Domingo City, reached after a long journey by auto, the Dominican officials received me with the greatest courtesy, and I was

soon again in the field on Samaná Bay, where with headquarters at Sánchez I had easy access to great swamps in the delta of Río Yuna, which drains the broad stretch of the Vega Real, to the waters and islands of the bay itself, and to the steep, forested hills inland. The caves in the limestone hills near San Lorenzo where native fishermen now live in as primitive fashion as the Indians preceding them who had left great shell middens as indication of their tenancy, and the colonies of pelicans, frigate birds, herons, and terns on the Cayos de los Pajaros were of especial interest.

Continuing after two weeks to La Vega I bargained for pack mules and was soon bound for the mountains of the interior. Leaving the palms and banana plantations of the lowlands, we traveled for miles through open forests of beautiful pines, climbed by narrow trails up the steep slopes of El Barrero, impassable during rains, and came finally to the interior valley of Constanza, where the air was cool and where, in winter, frosts come to kill tender vegetation.

At Constanza, the collections obtained included archeological as well as zoological material, for this had been one of the favored sites of the Indians, so that the country people found many pottery fragments and stone implements in cultivating their fields. Birds abounded, among them especially a song sparrow of the genus *Brachyspiza* with its relatives in South and Central America, and found elsewhere only in the interior mountains of this island. Dense deciduous forests covered many slopes, alternating with pines in pleasing contrast. A rare quail-dove inhabited the jungles, and trogons nested in hollow trees. In climate and topography, the region, except for its vegetation, was reminiscent of the mountains of Arizona and New Mexico. The return to the heat of the lowlands was made with regret, and work in the field was finally terminated on June 3 with departure for New York from Puerto Plata.

NATURAL HISTORY COLLECTING BY
DR. HUGH M. SMITH IN SIAM

By DORIS M. COCHRAN,
Assistant Curator, Division of Reptiles and Batrachians,
U. S. National Museum

Dr. Hugh M. Smith, formerly United States Commissioner of Fisheries and now director of the fisheries of Siam and honorary curator of zoology in the U. S. National Museum, has for the past few years collected natural history specimens in Siam for the Museum. During 1927, continued shipments of valuable material reached the Museum from Dr. Smith, especially during the early part of the year before his return to Washington for a visit.

One of his most interesting experiences was a visit to Koh Tao or Turtle Island, an island which is 40 miles from the mainland, further removed from the coast than any others in the Gulf of Siam. This island is uninhabited, seldom being visited even by the natives, and never before explored by a scientific collector. Needless to say, it yielded some new species, among them two distinct species of smooth-scaled lizards called "skins," and one beautiful little snake which is about as large as a pencil. It is reddish-brown above with a black ring around the neck and another near the end of the tail, which is light blue underneath.

Dr. Smith's own house and garden in Bangkok are excellent places to collect amphibians and reptiles. There is a tree near his verandah which is the home of a green bamboo-snake; he often sees this individual lying along a branch sunning itself and waiting for an unwary lizard. The house itself is not free from reptile invaders, as the little soft-bodied lizards called "house-geckos" are fond of taking up their abode wherever the moths are attracted by lights. The pond in his garden is a favorite resort of the water-snakes, which feed on the fish and on the amphibians which come there to breed. The common toad of Siam, often found in his garden, is decorated on the upper surfaces with sharp tubercles, black in the center and a deep raspberry pink at the edges.

Many odd forms of fish occur in Siam, although the dry season is very hard on them and they have had to adapt themselves in many



FIG. 42.—Dr. Smith's native assistant with a female fish-snake (*Homalopsis buccata*) which was captured in the garden at Bangkok. This individual is the largest one of its species of which we have any record; it measures 54 inches from snout to tail tip. The distention in the posterior part of the body is caused by the unhatched young of which there were about 16 embryos. The Siamese believe that this species is poisonous only when about to have young, but it is harmless, of course, at all times.

ways to withstand the yearly desiccation. Some aestivate in damp soil for as long a time as four months. A regular form of fishing in Siam is to dig in a dried-up marsh to the depth of two or three feet, where many fish called "serpent-heads" are to be found. These are very good to eat. The climbing perch *Anabas* is the most remarkable of all the aestivators; it is always popular in the markets, being sold



FIG. 43.—A very effective lizard-trap invented by the Siamese natives. It consists of a pliable splinter of bamboo about 28 inches in length in the form of a bow with a short cylindrical section left on one end. Through two small holes pierced in this section goes a running noose of stout cord. The cord is fastened to a wooden sliver, the point of which rests in a depression at the center of the bow. When the noose is drawn out and the trap is ready, the bow is under considerable tension, so that it is sprung at the least movement of the unwary lizard.

alive in baskets which are merely kept moist. This fish can climb steep canal banks by means of its tail and the large pectoral fins. It goes overland from one body of water to another and travels as fast as a man walking slowly.

During the year Dr. Smith collected about 200 species of birds, 18 of them being woodpeckers. One of the most daintily colored of all Asiatic birds is the Jambu fruit pigeon. The anterior half

of the head is deep crimson with a purplish brown stripe down the middle of the throat, the upper parts including wings and tail are brilliant green, the lower parts are white with the under tail-coverts chestnut, and with a wash of peach-blossom pink on the chest. Members of the crow and jay family were not numerous; one of the crested jays of Cochin China and Siam (*Cissa hypoleuca*), however, is especially handsome. It is a pale green above and greenish yellow below; the bill, wings and feet are red; there is a broad black stripe from the bill extending through the eyes and out to the tip of the long crest. In the course of a few years museum specimens are said to fade out, the lower parts becoming whitish and the green of the upper parts turning to blue.

The crustaceans sent by Dr. Smith have proved extremely interesting, as the specimens are always excellently preserved, especially some very fine "squillas," the largest ever received here.

The land shells number over 1,200 specimens and the collection contains several species not heretofore represented in our Siamese material, and likewise numerous specimens from new localities.

Dr. Smith's collections of mammals, insects, and plants are equally extensive, and his material in all branches is especially valuable since it augments the early work of Dr. W. L. Abbott who secured many specimens from the Malay Peninsula for the Museum.

THE CRUSTACEANS OF SOUTH AMERICA

By WALDO L. SCHMITT,

Curator, Division of Marine Invertebrates, U. S. National Museum

The conclusion of last year's account of my study of the crustacean fauna of South America under the Walter Rathbone Bacon Travelling Scholarship¹ left me on my way by steamer to that "Vale of Paradise," Valparaiso, Chile, which I reached November 18, 1926. During stops en route to discharge and take on cargo—stops often of some hours duration—intertidal collections were made at Tocopilla, Antofagasta, Chañaral, and Cruz Grande, Chile. Valparaiso I should call the San Francisco of South America in almost every respect, the business-like atmosphere, the hills, the narrow streets of the older town, and the stimulating "California" climate, all recalling the American city.

Through the kindness of Señor Doniez, part owner of the spiny-lobster fishing concession on the Island of Juan Fernandez, I had the good fortune to be furnished passage to that historic place, the one-time home of Alexander Selkirk, the hero of Robinson Crusoe. The spiny-lobster or crawfish fishery of Juan Fernandez is one of the largest of its kind and the total catch of over 87,000 individuals as given in the Chilean fishery statistics for 1925 for the two companies operating in those waters exceeds in number of pounds the combined catches made in California and Florida, where related species are taken for the market.

The extremely generous hospitality of Señor René Durand and his family rendered most pleasant and profitable a sojourn of 20 delightful December days in this veritable earthly paradise. Few places are blessed with such an ideal, healthful and fruitful climate. Preliminary studies on some of the zoological collections I brought back with me have disclosed a distinct species of New Zealand crab new to this fauna, and a spider of a genus known from South Africa, Australia, and New Zealand, and now found here, the first record for the Western hemisphere. The zoological evidence of the Polynesian and subantarctic affinities of the life of Juan Fernandez has never been as strong as that based on botanical data, and these two finds are therefore rendered all the more significant.

¹ Smithsonian Misc. Coll., Vol. 78, No. 7, p. 89, 1927.



FIG. 44.—The home of Señor René Durand, Juan Fernandez, Chile, where I was so hospitably entertained during my delightful sojourn on that romantic island.



FIG. 45.—Loading live "spiny lobsters" aboard schooner for transshipment to the Valparaiso market. As many as thirty-five hundred are carried alive to the mainland at one time in the well of the vessel.

It is a pleasure to acknowledge the cordial reception accorded me at the National Museum of Chile in Santiago by Dr. Eduardo Moore, the Director of that Institution; Dr. Juan Brüggen of the University of Chile; and Dr. Carlos E. Porter, the indefatigable Chilean zoologist. Dr. Porter is to be highly commended for his personal financial support of the *Revista Chilena Historia Natural*, the only periodical of its kind published in Chile.

In Santiago I visited Dr. Ernesto Maldonado, Director of the Chilean Forest, Fish and Game Commission, as well as the very excellent small museum maintained by this department. In consultation with Dr. Maldonado and Dr. Augusto Opazo of the Fisheries Service, plans were outlined by which the Smithsonian Institution would undertake to prepare a report on the crustacea of the coasts of Chile, based upon material to be collected and shipped to Washington for the purpose. To the American Ambassador to Chile, Mr. Collier, are due thanks for his kindness in lending a member of his staff to this preliminary discussion.

The Museum of the University of Concepcion, although small, is growing and covers a wide range of activities. It is the best museum of its kind that it was my pleasure to visit on the west coast of South America. That it is an institution of great promise is due almost entirely to the energy and enthusiasm of its Director, Dr. Carlos Oliver Schneider.

From Talcahuano, Castro on the Island of Chiloe was reached five days later, after short stops en route, permitting some shore collecting at Lota, and at Corral. Southward through Chonos Archipelago and the canals of southern Chile to the Straits of Magellan, the scenery in many respects compares favorably with that of the Inland Passage to Alaska. This vast stretch of coast from Castro south, over 1,000 miles in a straight line, is still a "terra incognita," with little more known of its resources and scientific potentialities than when Darwin first visited the region 84 years ago. Collections of animals were made at Punta Arenas, Chile, before visiting the Falkland Islands. In Punta Arenas is a wonderful little museum maintained by the Salesian Brotherhood. It is a treasure house of things and rarities Fuegian, and is well worth a visit by ethnologists interested in this fast disappearing race of Indians.

Port Stanley, Falklands, was reached after what I considered a rather tempestuous passage, during which the galley of the small schooner in which the journey was made was flooded, the potatoes and other vegetables washed over-board, and the motor-room hatch



FIG. 46.—English Narrows, Territory of Magallanes, Chile. The scenery in many respects is comparable to that of the Inland Passage of Alaska.



FIG. 47.—Teal Inlet, East Falklands. A treeless country given over to sheep grazing. Many interesting specimens of marine life were taken from the holdfasts of the kelp that is dragged ashore here, as fertilizer for the adjacent fields.



FIG. 48.—Port Forster, Deception Island, South Shetlands. Part of a fleet of eleven floating whale factories that made this harbor their rendezvous during the 1927 whaling season. The numerous birds in the foreground are a species of petrel, *Daption capense* (Linnaeus), commonly called "Cape Pigeon," feeding on whale offal.



FIG. 49.—The landing at Castro, Island of Chiloe, Chile.



FIG. 50.—The main hall, Museo Nacional, Santiago, Chile.



FIG. 51.—Museo Salesiano, Colegio San Jose, Punta Arenas, Chile. This small museum is particularly rich in relics of the rapidly vanishing Fuegian Indians.

stove in—all this in the course of what the Captain called fairly good weather! The Falklands are well-known in scientific annals chiefly through the visitations of Darwin and of the "Challenger," and through the collections of Mr. Rupert Vallentin. Most helpful assistance was extended me during more than a month's stay (February to April, 1927) on East Falkland by the Governor, the Colonial officials, and all the private citizens with whom I came in contact. The interest of the school boys of Stanley caused them to bring in a number of specimens which might otherwise not have been obtained; and a brief talk to a class of pupils at Teal Inlet resulted in establishing a new record of the occurrence of one of the rarer shrimps (*Campylonotus vagans* Bate), heretofore known from the Straits of Magellan, Cape Horn and South Georgia, taken by Miss Eileen Felton from the roots of kelp hauled from water about two fathoms in depth for the purpose of fertilizing the fields.

Taking advantage of an opportunity offered while in the Falklands, a trip was made via the once-yearly mail boat to Deception Island of the South Shetlands, the headquarters of the whaling industry of that region. On the way, several tow-net hauls yielded a number of organisms new to the National Museum collections.

In the course of my return journey to the States, beginning April 28 in the Falkland Islands, collections were made at several ports in Argentine Patagonia: Rio Gallegos, Santa Cruz, San Julian, Deseada, Comodoro Rivadavia, and Puerto Madryn. At Buenos Aires, through the continuing kindness of Dr. Doello-Jurado, Director of the Argentine National Museum, a loan of further study collections of crustacea was obtained. At São Paulo, Brazil, the Museo Paulista, from which we have had most helpful cooperation for a great many years, was revisited during the two days that the northward bound steamer was taking its cargo of coffee on board at Santos. I arrived in New York on June 7, reaching Washington two days later.

The most grateful acknowledgment is due to the memory of Mrs. Virginia Purdy Bacon and her son, Walter Rathbone Bacon, in whose honor she founded the travelling scholarship which made possible this general reconnaissance of the marine fauna of the greater part of the coasts of South America, resulting in more than 15,000 specimens, and many valuable notes and observations. A great deal of this material is new to the National Museum's collections, including many additional records of occurrence and distribution, and, as far as the limited preliminary studies have indicated, a number of species new to science.

NATURAL HISTORY STUDIES ON THE FLORIDA KEYS AND THE WEST INDIES

By PAUL BARTSCH,

Curator, Division of Mollusks, U. S. National Museum

THE CERION BREEDING EXPERIMENTS

Fifteen years ago at the invitation of Dr. Alfred G. Mayor, the then Director of the Marine Biological Laboratory of the Carnegie Institution, I joined his expedition to Andros Island, Bahamas. I was to devote my attention to the general invertebrate fauna of the region.

In looking over the general field, particularly that of mollusks in preparation for this work, I decided to let alone one group of these creatures, namely, members of the genus *Cerion*, for it was a somewhat tacit understanding that people who had devoted themselves to this group had become more or less hopelessly entangled in it, and some were even considered as having become slightly locoed.

The old saying about a certain group of individuals stepping in where angels fear to tread, proved again to be an established fact, for shortly after landing at the White House on South Bight, Andros Island, I found myself picking up what I later named *Cerion casablancae*, and that was the beginning of many years of work, for I am still at the problem and will probably continue to be for some time to come.

A little before going to the Bahamas, I had worked over the collection made by Owen Bryant on these islands, which was described by Dr. Dall.¹ That bit of work enabled me to understand why it took a man of Dr. Dall's standing to have the courage to describe new species of *Cerions* then. At that time it was the generally assumed belief that *Cerions* were a most plastic group, readily changing under the influence of changes in environment. In a general way we believed that a dry year might affect the food supply and activity and growth of individuals, and young born under such conditions would probably show the effect by having smaller shells or slightly different sculpture, or other characteristics that might differentiate them from individuals born under more propitious circumstances. It is a fact that at the beginning of our studies, very little was known about *Cerions* except descriptions of shells and that they usually occurred in large numbers wherever found.

¹ Smithsonian Misc. Coll., Vol. 47, Pt. 4, Publ. No. 1566, 1905.



FIG. 52.—*Cerion casablancae* as seen on Loggerhead Key where they have become abundantly established. Their ancestors came from Andros Island, Bahamas.



FIG. 53.—Some of the cages used in the early experiments of Cerion breeding.



FIG. 54.—Some of the little islands now used for Cerion breeding. These are separated by small trenches containing water.

My gathering of some 8,000 specimens in a space the size of an ordinary room finally caused me to cast caution aside and to take a large series of two races of these creatures with me to the Florida Keys, and there to subject them to all possible conditions of environment and to watch for results. We marked the Bahama specimens by putting two fine, closely spaced file scratches on the shell of each individual, and planted them in colonies of 500 each on Florida Keys, beginning with the Ragged Keys a little south of Miami and continuing from there south into the Gulf to the Dry Tortugas. It was somewhat of a surprise when we visited these colonies the next year to find that no adult offsprings were present. The same surprise was met the following year, and it was not until the third year that we found Florida grown individuals that had attained a mature stage. So one chapter was added to the life history of *Cerions*, that it took three years for Bahama *Cerions* to mature, not a single season as had previously been assumed. To this I may add that we have also found that *Cerions* from Curaçao and the Greater Antilles require an additional year to attain their full growth.

Succeeding generations have been kept in isolated colonies, and in that way we have been able to determine the part played by changes of environment. Of course we expected that we would get a broad expression of changes, for we had placed our colonies under all possible conditions of habitat which we believed would affect their food supply as well. At that time we believed that *Cerions* fed upon the plants upon which they climb, another error that our observations have rectified, for we now know that they dine largely, if not wholly, upon the fungal mycelia, minute plants and probably animals living immediately below the surface of the ground.

In our first experiments two species of *Cerions* were colonized on the Florida Keys, namely, *Cerion casablancae* and *Cerion viaregis*, the first coming from the south side of South Bight, and the second from the north side of South Bight at its eastern end. The first series of Florida grown offsprings secured showed no measurable characters differing from those found among specimens from the parent stock from the Bahamas. The second generation proved equally unresponsive, and it is this generation which is usually considered the critical one by naturalists, and here we had looked for possible expressions of changes due to the changed environment, for in this generation both the germplasm and somaplasm had a chance to adjust to the new environmental conditions.

These experiments therefore proved that *Cerions* were not as unstable in characters as some had held, but rather the contrary. Since then, other species have been added, namely, *Cerion uva* from

Curaçao, *Cerion crassilabre* from Porto Rico, of which we have also had two generations of Florida grown offsprings. While these took four years for development, they told the same story presented by the Bahama Cerions, namely, that they did not respond to changes in environment in these two generations. A number of other forms have since been added and are being subjected to the same critical tests.

On the Newfound Harbor Key in the Florida Key chain, we mixed a colony of *Cerion viaregis* with native Florida *Cerion incanum*, and great was our surprise to find three years later a hybrid between these two species. This was the more startling because the Florida group is not represented in the Bahama Islands, and its ancestors are traceable on the Florida Keys back to Oligocene times. The cross therefore was one of very distantly related things, and the specimens secured of the first generation of this cross were true hybrids showing intermediate characters between the two in about equal proportion to the two ancestors, and very uniform in appearance. The second generation of this hybrid group, however, was a surprise, for now an endless number of mutations appeared, covering almost everything in the field of Cerions except spiral sculpture. There is a tremendous difference in size, general shape, sculpture, and coloration in the various individuals.

This finding reminds one very much of De Vries' *Oenothera* problem, the basis of his mutation theory, due to a similar hybridization cause, and also that presented by certain of the more recent experiments on insects, and caused us to attempt the crossing of individual pairs of Cerions instead of the mass reaction as featured by the Newfound Key colony. For this purpose, cages were employed at first. The fine meshed screen of these cages, however, intercepted the formation of dew within the cages, which in turn apparently reacted on the food supply as well as the moisture supply of the Cerions, and resulted in killing them. The making of islands was then resorted to, and we have at the present time a series of small islands enclosed by trenches which are kept filled with water and serve as a barrier across which our mollusks will not pass. On these islands as well as in cut down cages—mere board enclosures with a strip of monel metal wire bent inward, tacked to the upper free edge of the boards, which leaves the central portion of the cage exposed to the normal atmospheric conditions—pairs of Cerions have been planted in the hope of obtaining the desired individual cross. These studies are going on at the present time. Meantime we have dissected 100 of the hybrids from the Newfound Harbor colony, and found most

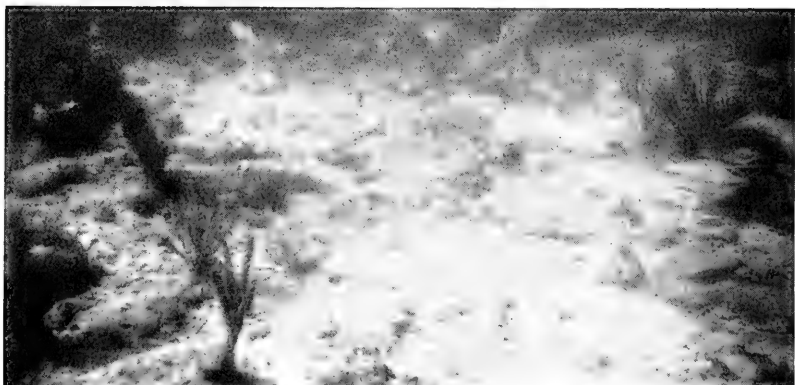


FIG. 55.—A sandy stretch with scattered Gorgonians at the edge of the reef.



FIG. 56.—The edge of the reef with a school of yellow-tails passing in review.

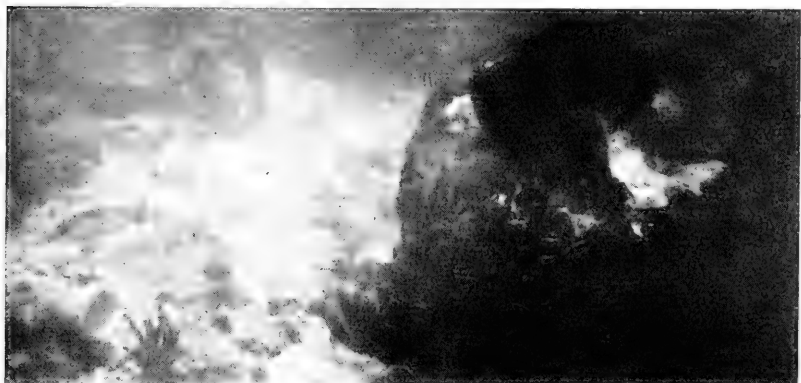


FIG. 57.—An isle in the massive reef with broken coral fragments, sand, and the associated fish fauna.

SUB-SEA PHOTOGRAPHS TAKEN WITH THE UNDER-SEA CAMERA.

interesting variations in the anatomy of these creatures produced by hybridization.

A series of specimens of *Cerion viaregis* Bartsch and *Cerion incanum* Binney were sent to Professor Charles Jeffreys, Harvard University, Cambridge, Massachusetts, for Chromosome studies. To these will shortly be added a series of the hybrids of these two species produced in the Newfound Harbor Key colony, for the same purpose.

Dr. Carlos de la Torre, of Havana, called my attention to a wild native hybrid of *Cerion tridentatum* and *Cerion paracuta* which occurs on the north coast of Cuba at Playa de Muerto a little west of Bahia de Jaruco. Under the guidance of Sr. Guillermo Aguayo, I visited the place and made a large gathering of specimens of both parents and hybrids. A series of these are now being dissected by students of mine at George Washington University, and specimens have also been sent to Professor Jeffreys for Chromosome study. The general picture presented by this native hybrid colony is similar to that which we produced by crossing *Cerion viaregis* and *Cerion incanum* on Newfound Harbor Key, Florida.

UNDERSEA ECOLOGY

The Tortugas region of the Florida Keys was long known as presenting one of the richest faunal assemblages on the Atlantic coast. For reasons not as yet entirely solved, but probably involving a number of factors, this fauna became materially reduced, and even at the present time, from a molluscan standpoint, is exceedingly poor.

During our Philippine cruise in 1907 to 1910, I became very much interested in the possibility of taking undersea pictures to show the ecologic conditions under which organisms exist, and during the 1912 cruise to the Bahamas I took a series of photographs through a truncate cone water glass from the surface. Later the development of the diving hood presented new factors, because by means of this apparatus one is able to spend as much time as one chooses undersea without great discomfort, and enjoy undersea rambles which give one an entirely new concept of the adjustments of creatures to the undersea environment. A view through a glass bottomed boat or a water glass does not reveal the subsea atmosphere as it actually exists, and you do not become conscious of this until you are actually undersea and looking in a horizontal direction, for then you at once become aware of the significance of the silvery sides of the pelagic fishes which correspond beautifully with the general tone of the background.

Hurricanes destroyed the major portion of the Staghorn coral reefs since our early visits to the Tortugas group, and these are now

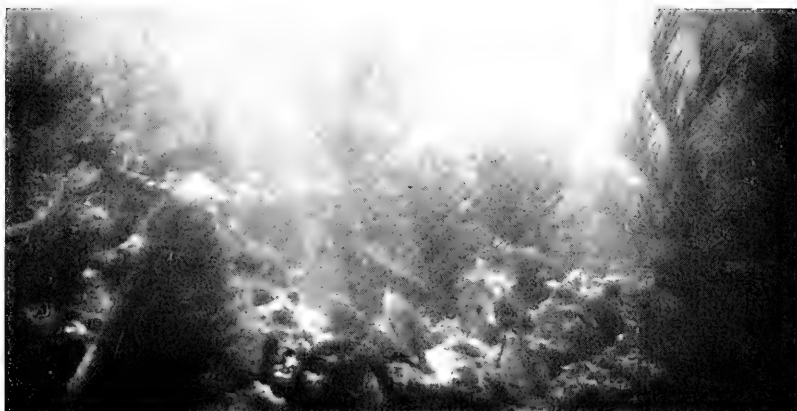


FIG. 58.—The plant-like organisms are Gorgonians, colonial Coelenterate animals; the fish are chiefly gray snappers.

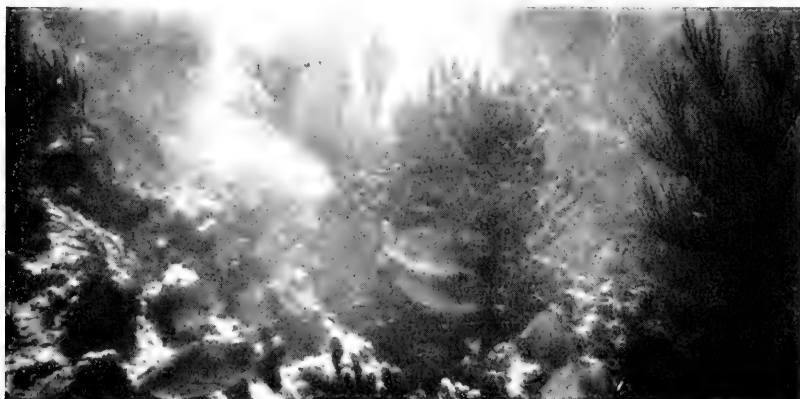


FIG. 59.—Another view of sub-sea life shown in Figure 58.



FIG. 60.—A massive coral head about which a school of fish is playing.
SUB-SEA PHOTOGRAPHS TAKEN WITH THE UNDER-SEA CAMERA.

rapidly coming back. A series of undersea photographs taken in different years in the same place show the changes which occur in the region from year to year, and over a number of years, produces a very interesting record as to what really takes place. Not only that, but with the aid of the undersea camera, it has been possible to show the associations of different types of animals in the different regions. These faunal associations are exceedingly definite and interesting not only to the student of living organisms but also to the student of fossil creatures, for you may have the reef building corals in one place with all the fish, mollusks, echinoderms, gorgonians, worms, etc., associated therewith, and not more than 50 feet away you may have a grass flat with an entirely different assemblage of creatures always found there and peculiar to such a place. If you were to have these creatures fossilized, and you had two exposures, one yielding the grass flat fauna and the other the reef fauna, you might be hard put to understand that these things were really synchronous elements. In order to have a definite record of the changes and also faunal associations, I have taken undersea pictures of these things, as time permitted, and likewise a series of undersea moving pictures, which show the animals in action. During 1927 I added 2,900 feet of moving picture film and 144 O Graphic films.

WEST INDIAN LAND SHELL STUDIES

The late Mr. John B. Henderson, formerly a member of the Smithsonian Board of Regents, had intended to devote the major portion of his scientific efforts to a study of the West Indian land shell problem. With that end in view, a number of expeditions were made by him and the writer, and various other friends, particularly Dr. Carlos de la Torre, of Havana, to many places in the Greater Antilles. These expeditions, as well as old collections purchased by Mr. Henderson and the material secured from collectors more recently has given to the U. S. National Museum probably a larger series of West Indian material than is contained in all the other museums of the world together. Thanks to financial aid rendered by Dr. Charles T. Simpson, of Little River, Florida, it has been possible to obtain necessary assistance to push this work on the West Indian land shell problem more rapidly than would otherwise have been possible, and this has resulted in the practical completion of a monograph on the large family of land shells known as the Annulariidae.

In order to make this monograph as complete as possible, the writer in September visited Dr. Carlos de la Torre at Havana, Cuba, to examine his rich private collection, which embraces by far the most magnificent assemblage of Cuban land mollusks in existence.



FIG. 61.—A group of brown Pelicans and Boobys on Bird Key, Tortugas, Florida, on the old foundation of the house which once upon a time stood well within the island, but now is at sea.



FIG. 62.—A group of Turnstones on the beach of Garden Key, Tortugas, Florida.

It is the product of a lifetime of collecting by a veteran naturalist assisted by a corps of associates, students, and loving friends. The month spent in reviewing the land shells of this family in his collection resulted not only in the material expansion of our systematic knowledge of the group, but also in the discovery of almost 200 unnamed forms. It likewise revealed that there still remained a number of regions in that large island which have been untouched and which will yield a rich harvest to the collector. The granting of the Walter Rathbone Bacon Travelling Scholarship by the Smithsonian Institution to the writer will make it possible to explore these regions before the manuscript on this family is sent to press. During our study at Havana the collections of the Academy of Sciences, Colegio de la Salle, and Colegio de los Escolapios were also examined, and interesting information gleaned therefrom.

The study of the West Indian land mollusks soon revealed that while Jamaica already possesses some 600 named forms of land shells, largely described by Professor C. B. Adams of Amherst College, most of these specimens were without definite locality data, and for that reason it was deemed desirable to have some one finetooth comb this island in order that we might be able, by comparing Adams' material with these new collections, to fix type localities for these older species. This would likewise enable us to determine the range of distribution of Jamaican forms. With this end in view, Mr. C. R. Orcutt was prevailed upon to visit the Island, and he has now spent a little more than a year in the pursuit of mollusks and has sent thousands of specimens to the National Museum which will help to clear up the problems mentioned above.

For the same reason Mr. Walter J. Eyerdam spent several months in collecting land shells in unexplored portions of Haiti, which will also assist in elucidating problems in zoogeographic distribution in that Island.

Here, too, should be mentioned the contribution made in this direction by Dr. Alexander Wetmore's expedition to the same island, which added a number of novelties.

These studies of West Indian land shells are exceedingly fascinating and interesting, for they throw considerable light upon the derivation and distribution of the West Indian faunas.

BIRD STUDIES ON THE FLORIDA KEYS

In 1927, as during the past 15 years, I kept records of the birds seen during my visit to the Florida Keys. This has resulted in the accumulation of a large amount of information upon the migration of

birds and the breeding habits of resident species, and has likewise furnished some interesting data on the adjustment of birds to changes of conditions. Bird Key, a small island of the Tortugas group, which was some 400 by 200 feet when I first visited these islands, has shrunk to a little more than a third of that size through the action of hurricanes and other storms. Here some 30,000 Sooty and Noddy Terns come annually to breed. Fifteen years ago the Noddies bred exclusively in the Bay Cedars and other trees, even in the axils of the leaves of the tall coconut palms. All of the trees having been destroyed by storms, the Noddies are now breeding upon the ground as the Sooty Terns have always done. Photographs were taken year

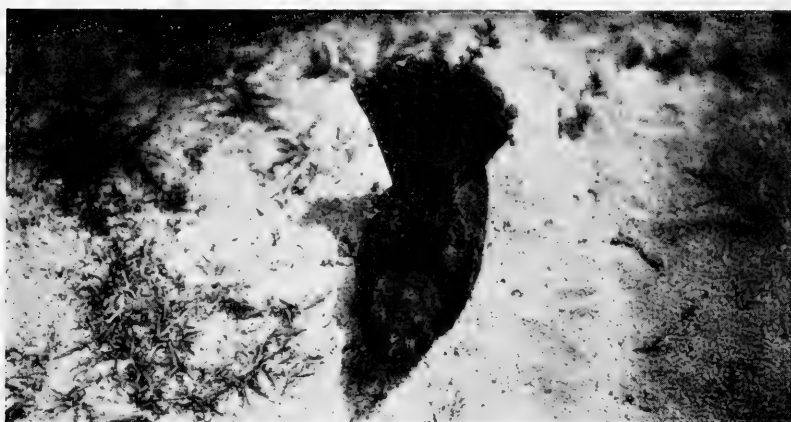


FIG. 63.—A Chuckwillswidow, a relative of the Whippoorwill, on Loggerhead Key, Tortugas, Florida.

by year showing the gradual adjustment from the tree nesting habit to brush nesting, and finally to sand nesting. It is interesting to observe such a tenacity to a nesting site, particularly so since Loggerhead Key, which is only a short distance away and across which the Terns are constantly flying, is still heavily covered with Bay Cedars but has not been chosen as a new nesting site by the colony.

This year yielded one addition to the birds previously recorded¹ for the Tortugas group—the Nonpareil, *Passerina ciris*, seen and photographed on Garden Key. We also secured a series of photographs from a blind of the following birds: Least Sandpiper, Semipalmated Sandpiper, Sanderling, Willet, Spotted Sandpiper, Semipalmated Plover, and Turnstone. A report upon the 15 years of bird observations upon the Florida Keys is in preparation.

¹ A summary of the records was published in the Smithsonian Report for 1917, pp. 497-500.

THE NATURAL HISTORY OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE

By PAUL BARTSCH,

Curator, Division of Mollusks, U. S. National Museum

At the invitation of Mr. Copley Amory, of Washington, D. C., a collecting expedition to Mr. Amory's estate on Matamek River on the north shore of the Gulf of St. Lawrence was sent out in the summer of 1927 by the U. S. National Museum. The party consisted of Mr. and Mrs. Paul Bowman, of George Washington University, and the writer. It was Mrs. Bowman's purpose, under the writer's direction, to gather as much as possible of the local marine invertebrate faunas, particularly mollusks. With these specimens was to be kept an accurate record of the environmental conditions under which these organisms exist, including depth, character of bottom, bottom temperature, and salinity. Samples of bottom and water were to be taken also at every station.

Mr. Amory placed at the party's disposal a power boat and a spacious laboratory well equipped with all the needed outfit for oceanographic research, and saw to it that we were well housed and more than well fed. Not only that, but he was ever ready to give us the benefit of his knowledge of local conditions acquired through many years of summer residence at this place, as well as actual personal help, and this meant much, for our party consisted largely of land lubbers, while Mr. Amory might enter a race with any seaman in bending on a dredge or splicing a line.

A series of hauls were accordingly made along the coast. In addition to the marine dredging, careful collecting was done along the beaches and the shallow water lagoons. The tide pools were made to yield their creatures by the judicious use of copper sulphate at low tide, which soon brings all animals not fixed to rocks from their hiding, and enables the collector to scoop them up with his dipnet. Mrs. Bowman also carefully explored the pools, lakes, and streams of the region for fresh-water organisms, and likewise made a careful search for land mollusks. The gathering of the latter was rather an ingenious proceeding. The land about Matamek is formed chiefly of rock, deficient in lime, with an acid soil condition which makes this

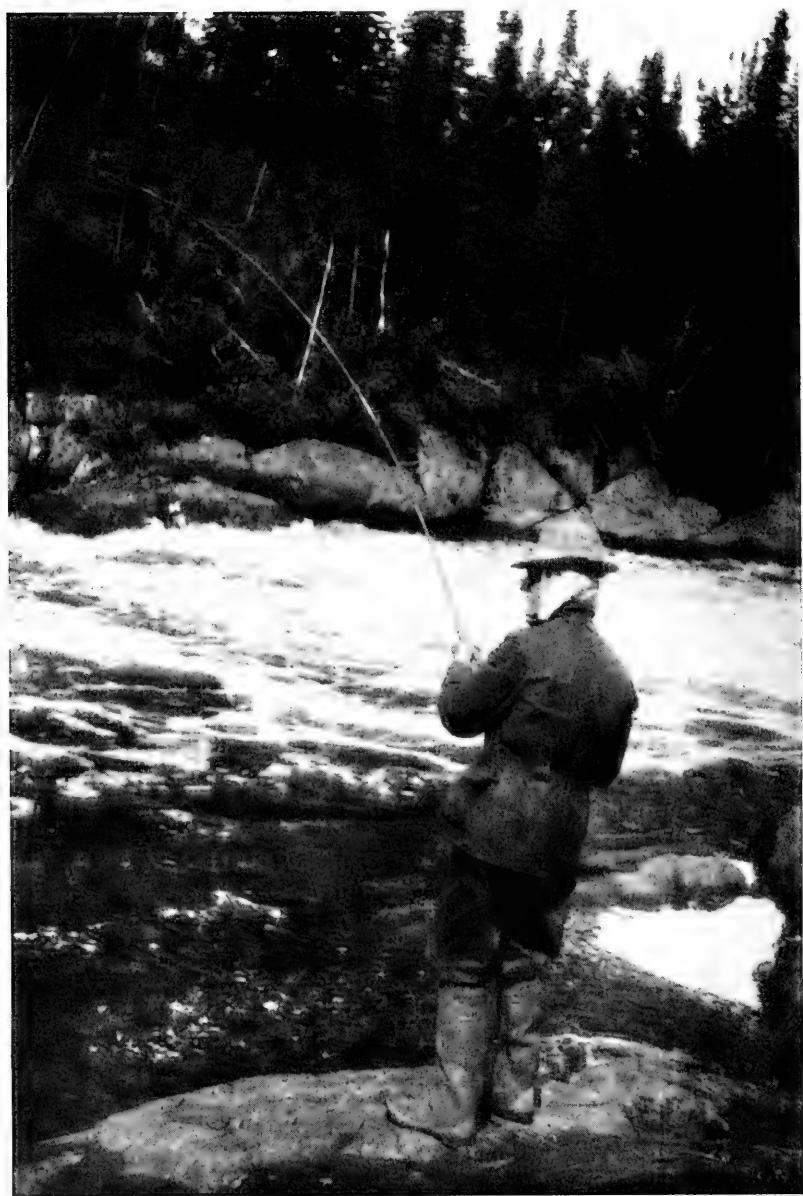


FIG. 64.—Salmon fishing on Matamek River, Canada.



FIG. 65.—The lower rapids of Matamek River, Canada, showing the characteristic vegetation of the region on its bank.

region a very poor habitat for land mollusks. These, therefore, are very poorly represented both in number of species and individuals. It was found, however, that they were as easily attracted to lime baits as mammals are to salt baits. By making a series of stations through the area, and placing a handful of lime in each, it was possible to sufficiently concentrate these creatures to secure a representative series from the region. In addition to these efforts, Mrs. Bowman made careful observation on the Ecto- and Endoparasites of all fish caught. She likewise made a careful analysis of the stomach contents of these animals.

Mr. Bowman devoted his time to a consideration of the plants of the region, covering everything from marine and fresh-water algae to the flowering plants. The latter presented an exceedingly interesting study. The short growing season in this northern latitude produced a condensation which is simply marvellous, each day presenting new assemblages, while the old passed out with equal rapidity.

We were there early enough to watch the trees break into leaf and bloom, and by the time the party left, September 2, many of the trees had reached their autumn tint and were shedding their leaves. Mr. Bowman made the interesting observation that, upon their arrival, the sea on the north shore was covered with floating grains of conifer pollen. This was before the conifers on the north shore had sprung into bloom, and he believes that this pollen was carried all the way from the south shore of the Gulf. The comparative seasonal development of those two regions would make an interesting study.

Mr. Bowman also made a careful investigation of the peat bogs and found an extended hochmoor which he says is still in an early stage of development, consisting of about seven feet of soupy sphagnum resting on a sand bottom. The oldest and most interesting deposit found was covered with a spruce forest and consists of about 11 feet of dark peat placed upon a bottom of gray sand and clay. Serial cores of these peat bogs were taken and the samples shipped to Washington for microscopic study. In these land explorations for plants, Mr. Amory generously provided an Indian guide whose experience and knowledge of the place were of inestimable value.

The writer returned after a short stay, and Mr. and Mrs. Bowman remained until September 2. A large amount of material was collected, including both animals and plants, a report on which was in preparation at the close of 1927.

THE FLIES OF THE WESTERN MOUNTAINS

By J. M. ALDRICH,

Associate Curator, Division of Insects, U. S. National Museum

Many mountainous regions of the western United States have never been visited by an entomologist interested chiefly in flies, and other such regions are poorly represented in the extensive collections of flies in the U. S. National Museum. For these reasons I undertook in the summer of 1927 to visit a number of localities of special interest in the West.

The vicinity of Wells, Nevada, was the most important of these. Here there are large mountains, the East Humboldt Range, carrying much snow in early summer and giving rise to several important streams. There is also some seepage from the range which produces marshes a few miles from the base in the high plateau adjacent, which has an altitude of a little more than 5,000 feet. In one of these marshes I had collected for an hour as I stopped between trains in 1911, with such surprising results (20 or more new species) that I had always intended to visit the place again. This I was enabled to do last summer, spending six days at Wells.

Next in importance was the Yellowstone National Park, where the forested and well-watered plateau of about 7,500 feet altitude seemed an ideal collecting region, but had been visited hardly at all by collectors of flies for the National Museum. My visit in August was a trifle late for the best weather, but the flies were more numerous than in any other place in which I had ever collected. Six days here gave excellent results.

Lake Tahoe, California, is a large and beautiful lake at 6,200 feet altitude, among the high Sierras. Moist meadows around the south end of the lake provided good collecting, and three days were spent here; I then moved down the east side of the Sierras past Mono Lake, where the dryness of the season gave no promise of success in collecting, and proceeded up Leevining Canyon to a camping place near its head, just above Ellery Lake. The altitude of the camp was about 9,500 feet, with large banks of snow only a few yards from the tent. Insects were naturally much less numerous in such a cold place, but those captured were of especial interest because of the great altitude.



FIG. 66.—In camp on South Fork of Platte River, Colorado.



FIG. 67.—Wells, Nevada, from the North.



FIG. 68.—Camp at Ellery Lake, California, near Tioga Pass, July 4.



FIG. 69.—Crossing Tioga Pass in the Sierras, July 4.



FIG. 70.—Highway along ocean beach, north of Santa Cruz, California.



FIG. 71.—Firehole River, Yellowstone Park, above Old Faithful.



FIG. 72.—Sylvan Lake, Yellowstone Park.

The higher portion of the Rocky Mountains in Colorado are still yielding many new species of flies, though numerous collectors have been there. I had hoped to make a stop at Tennessee Pass, at 10,430 feet altitude, where I had collected twice before, but my plans necessitated a rather early start from Washington and the season was still too early at the Pass, with freezing temperatures every night and cold rains by day. However, I stopped on the South Fork of the Platte River west of Pike's Peak at about 8,500 feet altitude and found good collecting; my camp here was a very satisfactory one.



FIG. 73.—On Ten Sleep Creek, Big Horn Mountains, Wyoming.

The Black Hills of South Dakota are important in the distribution of the mountain forms of life, since they represent the easternmost extension of the Rocky Mountain region. In 1892 I had collected there for two weeks, the results being now incorporated in the National Museum. Since the Hills are at some distance from all the transcontinental railroads, few entomologists have stopped there, and we possess almost no flies from the region except those obtained on my former visit. I had planned to make a stop there on this trip, but the season was too late by the time I had come that far back. It was therefore deemed expedient to visit the Hills on another trip, in the earlier part of the summer.

These were the chief localities included in the plan of the trip, but I had opportunities to collect in the forested foothills of North Idaho,

including the vicinity of Lake Waha and Craig's Mountain, south of Lewiston; Mount Moscow, near the town of Moscow, the type locality of many species described within the past 20 years; Gold Hill, and Yale, northeast and east of Potlatch.

In order to visit so many scattered places, the trip was made by automobile. My wife accompanied me, and we camped most of the way. Our route was to Colorado Springs, across the Rockies by Tennessee Pass, through Salt Lake City to Wells; thence to Reno, crossing the Sierras at Tioga Pass, just above our camp at Ellery Lake; thence across the San Joaquin Valley to Monterey and north to San Francisco; up the Sacramento Valley and through Western Oregon to Portland, and through the Inland Empire to Spokane; thence by Missoula, Butte and Three Forks to the Yellowstone Park; crossing the Big Horn Mountains in Wyoming, and home across South Dakota, Southern Minnesota, etc. The distance traveled was over 9,000 miles, and the trip was made without mishap. The accompanying illustrations show a few of the collecting places and something of the traveling and camping conditions.

Several thousand flies were brought back; it will require more time to study the material sufficiently to tell how many species new to science were obtained, but there is no reason to doubt that the results were of substantial value.

BOTANICAL EXPLORATION IN EASTERN COLOMBIA

By ELLSWORTH P. KILLIP,

Assistant Curator, Division of Plants, U. S. National Museum

Little is known of the plant life of the Eastern Cordillera of Colombia north of the Bogotá region. No expeditions from the United States had previously visited the area, and the collections of the few European botanists to penetrate this not easily accessible region—Linden, Kalbreyer, Karsten, Funck and Schlin—consist mainly of the more showy plants. Moreover, very few of these specimens have found their way into American herbaria, so in continuation of the botanical exploration of northern South America, begun in 1917 jointly by the New York Botanical Garden, the Gray Herbarium of Harvard University, and the National Museum, Mr. Albert C. Smith, collaborator in the Division of Plants, and I spent the winter of 1926-1927 in Colombia, mainly in the eastern mountainous region. In the present enterprise cooperation was extended also by the Arnold Arboretum.

In arranging for the trip and in carrying out our plans valuable assistance was received from the Colombian Minister to the United States, the Pan American Union, the United Fruit Company, the governors of the various departments visited, and the representatives of several American commercial houses in Colombia.

We arrived at Cartagena October 29, 1926, and spent several days collecting at La Popa and Boca Grande and on Manga and Tierrabomba Islands, all of which are botanically historic localities in the vicinity of the port. Turbaco, a village at the crest of the low hills east of Cartagena, was our next base. Here Humboldt and Bonpland spent several days before ascending the Magdalena River on their way to Quito, and it is the type locality for several species. Though a considerable part of the land is at present under cultivation, dense woods still remain to the westward and nearly impenetrable thickets cover considerable areas. Particularly interesting were the mud volcanoes, about nine miles from Turbaco, where we made fairly large collections.

A three days' trip up the Magdalena River next brought us to Puerto Wilches, the terminus of a railroad which eventually will reach into the heart of the Eastern Cordillera. Collections were made

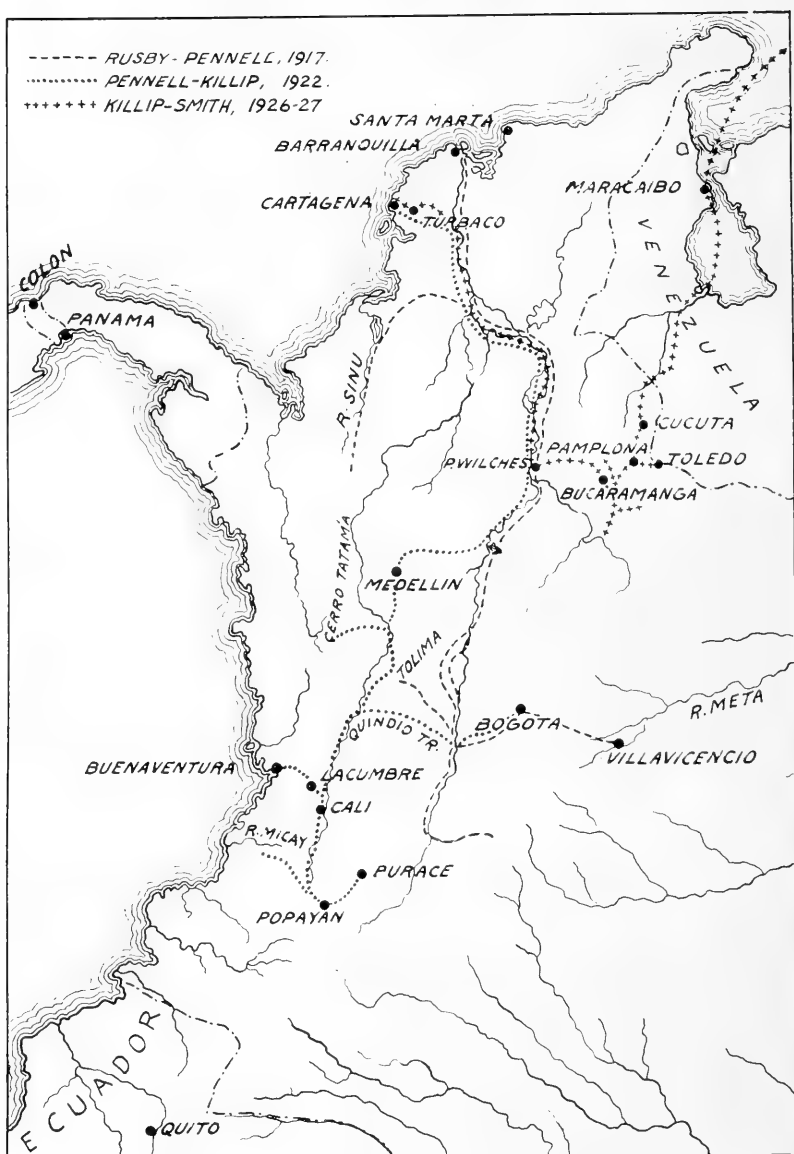


FIG. 74.—Routes of the three expeditions to Colombia in which the Smithsonian Institution has participated.



FIG. 75.—Old walls of Cartagena.



FIG. 76.—Village on Tierrabomba Island, Cartagena Bay.



FIG. 77.—Mud volcanoes near Turbaco.

in the dense tropical jungle surrounding the town and extending eastward to the base of the mountains.

On December 3 we left the railroad at Provincia, the eastern end of the portion which is open for traffic, and from then on, until we emerged from the mountains on the far eastern side near Cúcuta, our only means of transportation was by mule.

Once in the mountains, headquarters were established at the delightful city of Bucaramanga, and this served as our main base for two and a half months. Bucaramanga is one of several thriving Colombian cities linked to the outside world only by mule trails and airplane. Its streets, however, are filled with autos and autobuses and its shops are well stocked with goods from this country and Europe. The capital of a department in which coffee is abundantly grown and which leads in the production of oil, it is at present experiencing a high degree of prosperity. The Governor and other officials of the Department of Santander, as well as private citizens, extended every courtesy to us, and much of our success in collecting about 17,000 specimens in this area was due to this highly appreciated cooperation.

Situated on a plateau which drops abruptly to deep valleys on three sides, the immediate vicinity of Bucaramanga was not especially interesting botanically; but areas to the south, east, and north, distant two to four days by mule travel, were exceedingly rich. The Mesa de los Santos, a broad plateau about 1,500 meters above sea level, was first visited. Although there was no range of altitude here, the presence of dense woods, sandy fields, marshes, and rocky cliffs, all within a few miles of our inn, resulted in a wide diversity of plant life.

Our second trip from Bucaramanga took us eastward to the isolated region about Las Vegas. From our base established here at 2,600 meters, in the midst of a rich vegetation, a two days' trip was made to the Páramo de las Vegas, the highest point of which lies at 3,800 meters elevation. Among the more interesting plants collected along this trail were the Colombian May-flower, with showy magenta flowers, a scarlet-flowered loranthus, related to our mistletoe, a species of adder's-tongue fern, several rare passion flowers, the large-fruited blackberry, and a species of *Espeletia*. This last group of curious woolly plants, locally known as frailejones, is characteristic of the higher mountain plateaus.

The month of January and the first part of February were spent about Suratá, Charta, and California, to the north of Bucaramanga, an area thought to be well worth visiting because of the rich collections made there by Linden and by Funck and Schlim. From California,



FIG. 78.—Indians of the páramos, their hut 4,000 meters above sea-level.



FIG. 79.—The Expedition's headquarters on the Mesa de los Santos, along the main road from Bucaramanga to Bogotá.

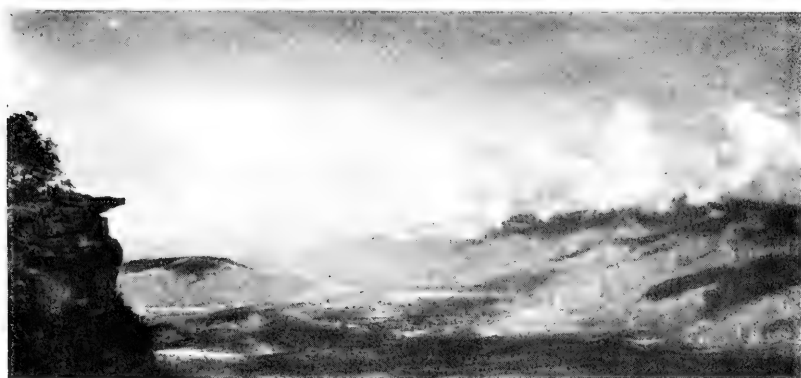


FIG. 80.—View from edge of Mesa de los Santos toward the Las Vegas mountains.



FIG. 81.—Mountains near the Colombian-Venezuelan border; the village of Labateca at the right.



FIG. 82.—Smithsonian Expedition crossing the Páramo of Santurbán, at an altitude of 4,500 meters.



FIG. 83.—Loading bananas at the United Fruit Company dock, Santa Marta.



FIG. 84.—Drying plants over oil-burners in the patio of a school, Bucaramanga.



FIG. 85.—Morning-glories cover the shrubs at the edge of the mud volcanoes, Turbaco.



FIG. 86.—A typical páramo scene, showing one of the larger frailejones.

Mr. Smith made a week's trip to the páramos of Vetás, Santurbán, Mogotocoro, Rico, and Frailejonale, and I spent the following week in the vicinity of La Baja, visiting the páramos of Las Puentes, Las Coloradas, and Romeral.

On February 18 we started on our long journey to Pamplona over the vast páramo of Santurbán, the bleak region that so effectively cuts off the northeastern part of Colombia from the rest of the country. In the immediate neighborhood of this city nearly all the land had been cleared, so we moved on at once to Toledo, due east and close to the Venezuelan border. Here, at the headwaters of the Orinoco system, a flora vastly different from that to the westward was found.

Having completed our work in the Eastern Cordillera we proceeded back to the coast as directly as possible, by way of Cúcuta, Maracaibo, Curaçao, and Puerto Colombia, making small collections at each of these places.

In the course of the present exploration approximately 7,200 collecting numbers were obtained, represented by nearly 30,000 specimens. In this collection are about 800 numbers of ferns, 300 of orchids, over 200 of the mimosa and cassia families, approximately 75 morning-glories and 100 passion flowers, and nearly 700 Compositae; about a third of the collection consists of woody plants. Sets have been distributed to the cooperating institutions and the work of identification has been begun.

The routes of the three expeditions which have gone into Colombia in connection with the present exploration work are shown on the accompanying map (p. 74). Although 60,000 specimens in all have been collected, there are, it will be noted, several wholly untouched areas, such as the Amazon and Orinoco basins in the southeastern part, the northwest section adjacent to Panama, and the Pasto region, near the Ecuador border. Additional work should be done also in the Santa Marta Mountains and among the isolated peaks at the northern end of the Western Cordillera.

A SEARCH FOR RUBBER IN TEXAS

By J. N. ROSE,

Associate Curator, Division of Plants, U. S. National Museum

To learn whether any of the native plants of central and southern Texas might be of value as a source of rubber, I visited that region in October, 1927, under the auspices of Mr. Thomas A. Edison. Inasmuch as the United States Department of Agriculture is also greatly interested in possible new sources of rubber, Mr. Paul G. Russell was detailed by that Department to accompany me.

We left Washington October 5 and returned November 11. A small automobile was used in the work, enabling us to cover a much wider territory than would otherwise have been possible. We began work at Austin, Texas, making the University of Texas our headquarters, from which, under the direction of Prof. B. C. Tharp and his colleagues, we thoroughly explored that region. One day was spent in studying the interesting flora of the Edwards Plateau, and on another day we visited the new site of the University's botanical garden, which includes 500 acres lying on both sides of the Colorado River. This area is very suitable for a botanical garden, for the land is exceedingly diverse, consisting of high river bluffs, tree-covered knolls, deep canyons, and wooded flats. It supports a rich native flora and, when improved with good roads, will be one of the most interesting localities in all central Texas.

After a week at Austin we motored south through New Braunfels, the site of an old German colony and the home of two remarkable botanical collectors, Dr. F. Roemer and Dr. F. Lindheimer. The latter made very large collections in this region and sent the specimens to his countryman, George Engelmann, then a physician in St. Louis and an enthusiastic student of plants. Later, Engelmann published in the Boston Journal of Natural History an important paper entitled, "Plantae Lindheimerianae," based on Lindheimer's collections and containing descriptions of many new and rare plants. A common cactus, *Opuntia lindheimeri*, perhaps the commonest species of this family in the United States, is abundant about New Braunfels and was traced by us as far south as Brownsville.



FIG. 87.—*Ebenopsis flexicaulis*: a shade tree in Brownsville, Texas; native of southern Texas and northern Mexico.



FIG. 88.—*Leucaena pulverulenta*: a shade tree in Brownsville, Texas; common in the surrounding forests.



FIG. 89.—Said to be the home of F. Lindheimer, near New Braunfels, Texas.



FIG. 90.—*Inodes texensis*: the Sabal palm of the Rio Grande Valley below Brownsville, Texas.

We then motored to San Antonio, where we visited the beautiful rock garden of Dr. and Mrs. D. T. Atkinson, to which the Smithsonian Institution has contributed several shipments of living plants. From San Antonio we went down the Rio Grande Valley, passing through extensive orange groves. Brownsville is a very old town, and is of considerable botanical interest, many of the street shade trees being native to the region. One of these is the Sabal palm, *Inodes texensis*, resembling very much the Washington palm, which has been introduced into that part of Texas. I was especially interested also in other trees belonging to the Mimosa family, a group which I am now studying. One of these is a species of *Leucaena*, usually passing as *L. pulverulenta*, which has finely cut leaves and heads of small flowers. The other is a species of *Ebenopsis*, a new genus which at the time of our visit had not yet been published. This tree has very hard wood, which takes a beautiful polish and is known as Mexican ebony.

The Sabal palm was doubtless once common in the Lower Rio Grande Valley, and is still represented by many scattered trees and several fine groves. It occupies very fertile parts of the valley and is therefore gradually being eliminated. An effort should be made to have at least one of the groves reserved as a state park or monument. Not only are the palms themselves unique, but the undergrowth about them contains many interesting and rare plants. The appearance of the groves is shown in the accompanying photographs.

With Brownsville as headquarters the surrounding territory for a distance of about 100 miles in all directions was surveyed in an attempt to discover rubber-yielding plants. This included three trips into adjacent Mexico southeast, south, and southwest of Matamoros. The southern trip extended as far as San Fernando, on the Rio de Conchas.

Although many plants were examined to determine their rubber content, our results were chiefly negative. Near Brownsville we found a variety of the common poinsettia (*Poinsettia pulcherrima*) which grows very abundantly. It produces an abundance of latex, which gives about nine per cent crude rubber, and although previously not regarded as very promising, yet deserves further study.

As a result of this trip a valuable series of herbarium specimens was brought back, including many rare species and others that are of special interest as coming from the locality whence they were originally described.

A BOTANICAL TRIP TO FORMOSA

By HARLEY HARRIS BARTLETT,

Collaborator, Division of Plants, U. S. National Museum

The flora of Formosa, rich in endemic species, has been made known for the most part through the publications of Japanese botanists. In the early years of the Japanese occupation, before the aborigines of the mountains had been brought under complete control, botanizing was carried on only with difficulty and danger. In consequence, few duplicates were collected, and the herbaria at Taihoku, the Formosan capital, and Tokyo are the only ones that adequately represent the flora. American herbaria lack Formosan plants almost entirely, except for the collections of Wilson of the Arnold Arboretum and some grasses collected by Hitchcock. I therefore felt that it would be decidedly valuable to secure even the small amount of material that could be got in a brief trip, and so made use of the five weeks preceding the Third Pan-Pacific Science Congress at Tokyo in a botanical trip to Formosa.

The western half of Formosa is flat, fertile, densely populated and tame. The formerly turbulent, semi-barbarous Chinese population has been efficiently organized by the Japanese; railroads have been built; rice, sugar cane, banana and other cultures have been systematically developed. Consequently the chief interest of this part of the island is in its advanced and scientific agriculture. The eastern half is rough and wild. Head-hunting by the Malayan aborigines has been suppressed, and the Japanese have made wonderful progress in gaining the confidence of the natives. They have established schools, improved living conditions, and seem to be dealing very wisely with the tribes.

I arrived in Kilung on September 22, 1926, and went at once to Taihoku. On board the SS. *Fuso Maru* I had made friends with Professor Masakazu Sato, plant biochemist of the Taiwan Agricultural College. He introduced me to Dr. Kintaro Oshima, the Head of the College, and Director of the central agricultural experiment station, and through the latter I met Vice-Governor Goto. Plans for a trip in the savage districts were soon made and approved. Dr. Oshima very kindly arranged that Mr. Kindi Yamada, Expert in



FIG. 91.—Formosan (Chinese) fishermen drawing in a seine at Suwo, on the eastern coast of Formosa. Many of the bowlders on the shore are dense, hard, wave-worn coral.



FIG. 92.—Many baskets of small fish and crabs came out of the net and one big eel of diabolical looks and disposition.



FIG. 93.—A scene in the Ami village Pokpok near Kwareuko. Notice the Formosan dog at the corner of the rice granary at the right.

Forestry at the Government Research Institute, Taihoku Botanical Garden, should be released from his duties to accompany me. Thus I was provided with an indispensable guide and friend. Mr. Yamada spoke both Japanese and Chinese, as well as English and one of the aboriginal languages, Paiwan. In our journeys together my lack of understanding of Japanese etiquette must at times have been embarrassing to him, but his kindness and helpfulness never failed, even under the stress of days in the cold and rain, after which plants had to be straightened out and put in press at night.

We went by rail to Rato, on the east coast, around the northern end of the island, and then struck inland to Taiheisan, a mountain whose age-old forest of gigantic conifers is being forested. We followed up the narrow-gauge gravity railroad by which the logs are sent down. A primitive but efficient brake and a Chinese driver controlled the cars, piled high with enormous logs, most of them from the two species of *Chamaecyparis*, counterparts of our white cedar, which form the bulk of the coniferous stand. The track might follow a niche in a canyon-like wall, or traverse a temporary trestle, but whenever the sound of the down-coming trains was heard there was nothing to do but find some place to sidetrack as the cars went careening by. The empty cars were pulled back by patient plodding water-buffaloes quaintly shod with little straw sandals like those of the Japanese woodsmen.

On Taiheisan I saw the ancient relict conifer, *Taiwania*; the rare *Cunninghamia Kawakamii*; a counterpart of our East American *Sassafras*, *S. randaiense*; the anomalous *Trochodendron aralioides*, a fine tree, botanically noteworthy because it is one of the few angiosperms whose wood contains no vessels. A characteristic shrub which we always associate with Formosa was seen abundantly—the famous paper plant, *Tetrapanax papyriferum*, a relative of our devil's club, from the thick pith of which the pure white material is prepared upon which the Cantonese artists paint the bright little pictures that every globe-trotter for a hundred years has brought home.

After returning by gravity car from Taiheisan to the coast, we took a steamer from Suwo to Kwarenko. Here we visited the Ami tribe, a strictly coastal people who still preserve and revere the ancient canoes by which, according to their traditions, they came to Formosa. Hatsu-ne, near Kwarenko, was our point of departure for a trip on foot, with Taiyal carriers, across the central mountain range, following up the gorge of the slate-colored Mokka river. At the end of the first day's march we were served at a mountain inn with an American



FIG. 94.—Mr. Kindi Yamada, Expert in Forestry Research Institute, Botanical Garden, Taihoku, the writer's companion and friend on the trip through Formosa.



FIG. 96.—The Formosan paper plant, *Tetrapiptis papyrifera* C. Koch, between the Taichien Club and Doba. From the thick pure-white pith is prepared, by veneer cutting, the "paper" upon which the Cantonese paint the bright little pictures of mandarins, scholars, etc., that every tourist buys in China.



FIG. 95.—A station on the logging railroad up Taichien between the Taichien Club and Doba. The long trains come down by gravity. The tree is *beniti*, *Chamaecyparis formosensis* Mats.

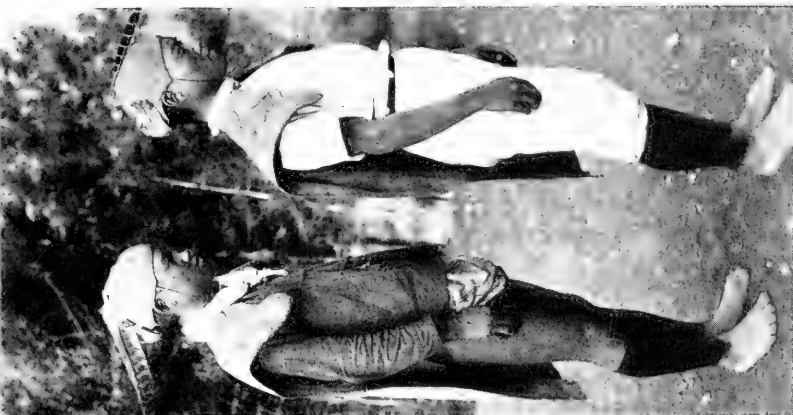


FIG. 99.—Young men of the Tsuo group, at Nanakaban, western approach to Niitakayama.



FIG. 98.—Taival man and woman of Hiat-sune. The thread carried by the man is spun from the fiber of *Boehmeria nivea*, grown in the mountain plantations of the natives.



FIG. 97.—Varavirin, chief of the Ami and his brother at Popokku.

dinner that would have been considered good in Washington. It was a special treat, prepared by Mr. Nagase, who had been 18 years in the United States, had served with Dewey at Manila, and then on the *Mayflower*, where he had talked with Presidents McKinley and Roosevelt. After dinner he called, and expressed his good will to the country he had served so long.

We crossed the divide at Nokosan, elevation about 10,000 ft. On the way I became more and more filled with admiration for the plucky Japanese officers who have brought standards of living into this wild land that do them infinite credit. They do the beautiful carpentry of their stations, using the trees in the forest as their raw material; they construct the carefully graded mountain paths, often blasted out of the face of the gorges; they build the wire suspension bridges that carry a footway of from one to three narrow boards; and they teach the native schools—all this in addition to their primary duty of keeping order. One whom I met had made a good herbarium; another, Mr. Mitsui of Raishya, whom I met later in South Formosa, had compiled an admirable dictionary of the Paiwan language which would be a genuine contribution to knowledge if it could be published, especially if it were romanized and included English as well as Japanese equivalents.

The mountain flora of Nokosan included many familiar boreal genera, which gave way, as we descended, to subtropical types, the whole transition being seen in a day's march. We got our botanical collections in order at Hori, where we were entertained by the genial Mr. Saito, Head of the Forest Experiment Station of the University of Hokkaido. (Each Japanese university has its own Formosan forest reserve and experiment station.) Mr. Saito is a butterfly enthusiast, and when he learned that we were returning to the mountains to climb Niitakayama (Mt. Morrison) he decided to join us. On the way to the top of the Japanese Empire we made very interesting collections, and saw the shy and attractive Tsuo tribe, who build little sacred houses of the skulls of the animals they kill in the chase. Our baggage carriers on this trip were the more primitive Bunun, the least engaging, perhaps, of the Formosan natives. We reached the summit, at about 13,400 ft., and made good collections.

My last trip into the mountains was to the Paiwan village of Raishya, reached from Heito, the southern terminus of the railroad. On the way we had the interesting experience of fording a Formosan river several times. Although shallow, the water was so swift that its impact made it almost impossible to get one's foot to the bottom.



FIG. 102.—Talus slope below the central peak of Mt. Morrison. The prostrate form of *Juniperus monosperma* borders the talus. About 12,000 feet elevation.

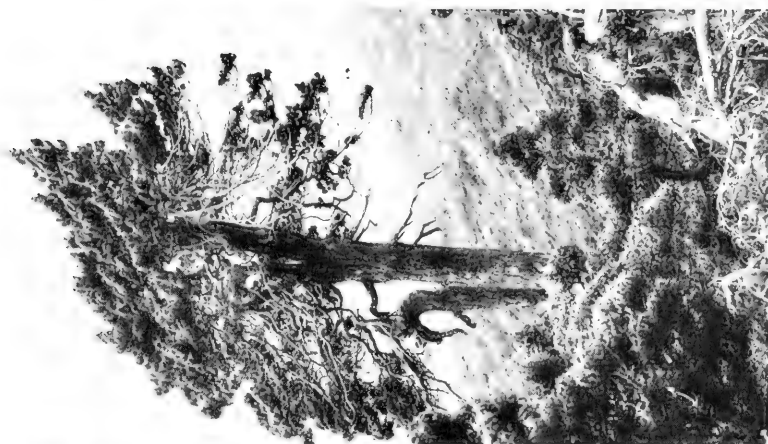


FIG. 101.—The most picturesque of Formosa's trees, *Juniperus monosperma* Hayata, at about 12,000 feet on Niitakayama. This species is by some considered identical with *Juniperus squinata* Lamb. It also exists at the same altitude in a prostrate form, which may prove to be a genetically distinct ecotype.



FIG. 100.—Inside of the skull house of the Tsuo at Namakahan. The Tsuo are a small group who no longer hunt human heads, but preserve carefully the heads of game (mostly wild pigs and deer) killed by them. The noses of the skulls are toward the inside of the skull house.

The friendly Paiwan exclaimed at my poor technique and came to the rescue. Raishya is built of great slabs of slate. The houses, with abundant carving in wood and stone, are very interesting. The people wear head bands of flowers and are most attractive.

On the return to Taihoku we stopped at a classic botanical locality on the west coast, Ape Hill at Takao. On this mountain of the short and low western range many botanical specimens were collected in the early days by Europeans, especially Henry. It has now been greatly modified by Chinese fuel and hay cutters, by being overrun with Lantana, and by reforestation with Acacia, but it is still an interesting locality for the rare and local palm, *Phoenix Hanceana*.

After returning to Taihoku I spent a few days in the Herbarium at the Botanical Garden identifying my collections—an especially important matter since type material for comparison exists only in



FIG. 103.—Old shelf with human skulls beside the door of a house in Raishya. It is only by accident that such a shelf has escaped destruction by the police. All the great shelves exist now only in memory and old photographs.

Japan. The specimens that could not be studied here, I compared in Tokyo at the Botanical Institute of the Imperial University. For many courtesies at the herbaria I am indebted to Professor Bunzo Hayata, the Nestor of Formosan botany, and to Mr. Yamamoto of Tokyo, and to Mr. Sasaki of Taihoku. In Taihoku I enjoyed the hospitality of the Japanese friends already named; of our energetic and helpful Consul, Mr. De Vault, and Mrs. De Vault; of the Dutch Vice-Consul, Mr. Nichols and his wife; and of Mr. Hosui of the Higher School, formerly chief of the Division of Foreign Relations of the Formosan Government.

Although only about 370 numbers of plants were collected, there are duplicates for several American institutions. The value of the collection is greater than the number would indicate, because many of the species have not heretofore been represented in American or European collections.

THE FAST-DISAPPEARING FLORA OF SUMATRA

By HARLEY HARRIS BARTLETT,

Collaborator, Division of Plants, U. S. National Museum

The establishment of plantations and the influx of population are rapidly sweeping away the jungles of Sumatra. To collect as much as possible of the fast-disappearing native flora, I spent the first half of 1927 there under the joint auspices of the University of Michigan and the Smithsonian Institution. Upon arriving in Asahan, Sumatra, December 25, 1926, I was occupied for a few days in making preparations for my work and in paying my respects to the Assistant Resident and the Toenkoe Regent, who gave me letters of introduction to other officials and to the native headmen. I was most fortunate in being invited by an old friend, Mr. James Grantham, Director of Plantation Research for the United States Rubber Company, to make his home at Boenoet my headquarters for the whole of my stay. It is a pleasure to acknowledge my indebtedness to the U. S. Rubber Co. and its staff for their assistance; to Mr. Carel Hamel of the American Methodist Mission, who proved an agreeable and helpful companion on several short jungle trips; to my former student, Mr. W. E. Cake, who joined me in a rapid trip around the southern end of Lake Toba to Taroetoeng; to Messrs. Stofkoper and Prokopovitsch of Loendoet Concession, Koealoe, for their hospitality there; and to Dr. H. S. Yates with whom I made an interesting, though botanically unproductive, visit to Poeloe Salah Nama, one of three rocky islets in the Straits of Molacca northeast of Batoe Bara.

The plantation belt of the East Coast is a region of rapid development, which had its beginning at Medan, center of the famous Deli tobacco plantations. Other cultures, especially rubber and oil-palm, have extended the belt southward, and now it is growing laterally toward the highlands through plantings of tea and, locally, of irrigated rice. The great plantations of the U. S. Rubber Co. in Asahan were practically the southern end of the culture area ten years ago, but now exploitation has reached much farther and has outdistanced transportation facilities.

It is regrettable that the resources of the jungle have not been known and utilized before its destruction. Of course the chief groups



FIG. 106.—Datoe Boersok of Silo Maradja. He stands before the altar to ancestral spirits, about to make an offering. In his right hand is a bamboo tube of sugar-palm wine, closed at the top with a bouquet of three kinds of sacred herbs (rocdang). The bowls contain rice of three colors (tawar,—purifier) to be thrown over the persons assembled.



FIG. 105.—Path through swampy jungle (rocdang) at Silo Maradja, Asahan. Such a path, known as lile-lite, is made by thrusting poles into the muck crossing each other so that V-shaped supports for small poles are left at the muck level.



FIG. 104.—Botanizing at Goeroe Batoc, Asahan. Dr. H. S. Yates carrying a collection of *Hydnoecarpus Yatesii* Merrill from the type locality.

of economic trees are known, but there are doubtless many localized types of great interest and value that are doomed to extinction. The expression of such fears provokes laughter in Sumatra, where the wonderful tropical forest now seems inexhaustible. However, it will be only a few years before a patch of virgin forest will be a rarity in the culture area. As for the flora, it is doubtful if half of it has been recorded, or can be recorded on the basis of the collections that have thus far been made. Furthermore, after potentially valuable or scientifically interesting plants have been exterminated, it is small consolation to know that a few fragments may be preserved in our herbaria. Since leprosy has come under control through treatment with chaulmoogra oil, what botanist would wish to see any one of the allies of chaulmoogra exterminated with its properties still unknown? The type locality of one of Mr. Yates' beautiful discoveries, *Hydnocarpus Yatesii* Merrill, may be cleared any time. The known range is not over ten miles across. It is a pity that botanical survey work cannot be pushed more rapidly the world over. Fortunately, two active botanists, Mr. J. A. Lörzing, in charge of the Sibolangit Botanical Garden, and Mr. H. S. Yates, until recently botanist for the U. S. Rubber Co., have been collecting in the East Coast region in the intervals of their other occupations. The former has assembled a valuable collection of living plants and has a book on the flora in preparation. The latter's collections, in the hands of Dr. E. D. Merrill for determination, will be reported upon by Merrill and Yates.

My own season of field-work extended from January to July, and included four not entirely distinct types of work.

1. Friendly contacts were made with the old native population at Silo Maradja, at the edge of the U. S. Rubber Plantations. Off and on throughout the season I stayed with these people and made collecting trips with them daily, collecting all plants of economic interest, as well as whatever else came to hand, and making notes on ethnobotany. Since the jungle people and their ancient lore are disappearing even faster than the jungle, this phase of my work was important. I fitted it into my program throughout my stay, by taking men from Silo Maradja with me to all the neighboring districts. Inquiries made on the trail always reminded these men of interesting things at home. An inseparable companion from Silo Maradja was Datoe Boersok, a picturesque old pagan priest-doctor, sometimes more picturesque than useful, whose fund of learning was always at my disposal. Rahmat was a cheerful boy of inexhaustible industry, who on one occasion felt so humiliated by his failure to climb a tree



FIG. 100.—The first burning of felled jungle, Locundiet, Kocaboe.



FIG. 108.—The base of one of the trees shown in figure 107.



FIG. 107.—Tocelang trees at the edge of a native clearing, Ack na Gerer, Tanah Djawa, Simeloengien. The trees are about 216 feet tall.



FIG. 110.—After the first burning. Ready for the second, or clean up, burning. Loendoet, Kocaloe. (Above the clouds in the distance the summit of Dolok Soeroengan.)



FIG. 111.—Crossing the Asahan below the Sampoeran Harimo (Tiger Fall) in a basket drawn on a single strand of rotan.



FIG. 112.—Transportation on the Toba trail. A Toba man carrying cooking pots down to Bandarpoeloe, at the edge of the culture belt. The other men are carrying chickens to the same market. They will return with dogs, a favorite food of the pagan mountaineers, but an abomination to the Muslim Malays of the lowlands. Photographed above Adian Langge, Asahan.

that he invented an excuse to leave his work the next day, returning triumphant with the flowers we had coveted. Oenoes, being of a practical turn of mind, preferred collecting seeds rather than herbarium specimens. I hope that some of his contributions to the Office of Foreign Seed and Plant Introduction may flourish.

2. Several weeks were spent in intensive work at Loendoet, south of the Asahan River. Several thousand acres of old jungle were being felled, and I might profitably have spent all my time there. Loendoet left a vivid memory of crashing jungle, the howling of disconsolate monkeys surrounded by smoke and crackling fires that followed the felling, the grotesque skeletons of charred trees that remained after the first burning, the little infernos watched over by Satanic Celestials during the second burning, when a hundred fires kept the sky aglow all night. The burning was followed by turning of the soil, and drainage of the swamps. Not a plant or animal remained. My day's routine was to clamber through unbelievable tangles of treetops and interwoven vines, many of them fish-hooked ratans, sometimes 20 or 30 feet above the ground. Often it rained, or the sun was scorching, but the wreckage never lost its interest. It was sad to see things dying that can never be replaced. My chief regret was for a magnificent *Dracaena* two feet in diameter. Many of the species were never seen in flower or fruit and must remain unrecorded.

3. I botanized hurriedly through the back of Asahan up over the mountains to Toba. This gave me a superficial idea of the floral changes as one ascends to the high plateau and the mountains from the low districts. The waterfalls of the Asahan, however insignificant they might seem in a paper comparison with the giant Niagara, are nevertheless sublime. No sight surpasses the plunge of the Asahan into a perfect bowl at the Sampoeran Harimo. This fall is at the head of the idyllic horseshoe valley of Tangga. Near the foot of the Tiger Fall I crossed the boiling Asahan on a single strand of ratan, ignominiously pulled in a basket, whereas the natives go hand over hand with the agility of monkeys. Then up the face of the valley, where the path becomes a series of ladders up the cliffs, and over the lalang plains of the ancient terrace to Toba. To stand at the mountain rim of Toba and look down at the great lake, the mysterious, almost-island Samosir, the emerald-green or golden rice terraces, the villages in their groves of trees and bamboo—nothing could be more entrancing. And then the mountains—each one presenting untouched botanical opportunities. The sacred Dolok



FIG. 113.—Radja Gilas marga Pandjaitan, of Pardoewaan, Habinsaran, and two of his children. The radja illustrates the fine features of most chiefs of Habinsaran.



FIG. 114.—Si Abi marga Pandjaitan, of Pardoewaan, a man of the chief's marriage sept but showing the features more common among the rank and file: curly hair, full lips, and a somewhat broad nose. An intelligent, industrious and good-natured type.



FIG. 115.—Pagar Batoe with Dolok Djomba in the background. A convenient base from which one may ascend to the summit of Dolok Soeroengan.

Soeroengan was the only one of the larger mountains south of Toba Lake that I could botanize clear to the top, and its possibilities I barely scratched.

4. Two trips were made to the Karo plateau at the north end of Toba Lake, where the U. S. Rubber Co. maintains bungalows at Běrastagi. From Běrastagi I botanized the two volcanoes, Si Naboen and Si Bajak, as well as the lesser mountains, Dělěng Piso-Piso and Dělěng Baroes and the hills, Dělěng Koetoe and Dělěng Singkoet.



FIG. 116.—Panapparan, a mountain village on Tor Dabolon, above the cliffs. The water from the higher levels is led to the rice terraces, which are a marvel of beauty whether green with the young plants or golden with the harvest. In the left background the summit of Dolok Si Riaria.

I collected ample material of several of Ridley's plants, which will be of value in interpreting his work, and also got many plants that will probably be new to the flora.

I stayed in Sumatra a little over six months, and brought back nearly 2,400 numbers, with many duplicates. At Loendoet my drying shed was destroyed by fire, with loss of many specimens and most of my equipment. It took some improvising to take care of the collections during a few days following the fire, but work was hardly interrupted.

THE GRASSES OF OREGON AND WASHINGTON

By A. S. HITCHCOCK,

Custodian, Section of Grasses, U. S. National Museum

In connection with the preparation of a manual of the grasses of the United States, I spent about 10 weeks in the study and collection of grasses in Washington and Oregon. During much of the time I was cooperating with the Forest Service, and many of the trips were made in company with Mr. D. C. Ingram of the Portland office, a botanist with a wide knowledge of the flora of Oregon.

The Olympic Mountains were visited at Solduc Hot Springs and collections were made at Port Angeles and other points in western Washington. In Oregon Mr. Ingram and I, with the aid of Forest Service officials, especially the rangers, visited various localities in the Cascade, Deschutes, Umpqua, and Siskiyou Forests. Much of the exploration was by horseback, using camp equipment or stopping at ranger stations. In this way I was in intimate contact with grazing conditions and could study the grasses in their native habitat under varying environment. We crossed the divide going east over McKenzie Pass. This region illustrates excellently the immense lava flows that cover large areas with rough lava that does not yet support vegetation. Older flows are covered with forest. Passing through Bend in the semi-arid region east of the Cascades we again entered the forest and visited many of the beautiful lakes, such as Odell, Crescent, and Davis. After several days' travel over the mountain trails of the Umpqua Forest we went to Grant's Pass and started on an exploration of the Siskiyou Forest. We used the main autobus road to Crescent City, California, but made side trips to Pearsall Peak, Tennessee Pass, Sanger Peak and other points. From Crescent City we followed the coast north to Bandon, making collections at several points, and then crossed to Roseburg.

Trips were made to Mt. Hood and The Dalles, and, to consult collections of Oregon grasses, to the herbaria of Willamette University, Salem, the Agricultural College, Corvallis, and the State University, Eugene. Forest fires prevented proposed trips to Mt. Adams and Mt. St. Helens, in Washington.

The object of this trip and also of the one made by Mr. Swallen, whose account follows, was to determine the amount of variation



FIG. 117.—Lookout Station on Sanger Peak, northern California, in the Siskiyou National Forest. These stations are placed on the high peaks to aid in fire protection. A lookout man lives here during the summer months. He is on the watch for fires. The notice of a fire with its direction is at once telephoned to a central station. The living room is below, the observation room above.



FIG. 118.—California pitcherplant (*Darlingtonia californica*) in a bog along Josephine Creek, near Kerby, Oregon. The leaves are tubular with an arching hoodlike summit, beautifully mottled with purple. Large numbers of insects are found in the old leaves. The species is allied to the pitcher-plants of our southeastern states (*Sarracenia*).



FIG. 119.—McKenzie Pass, Oregon. The main road from Eugene to Bend goes over the Cascade Mountains at this point. The whole region has been covered with a series of lava flows. Here are shown comparatively recent flows passing around a hill of earlier flows. The recent lava does not yet support vegetation.



FIG. 121.—A beautiful and conspicuous white lily (*Lilium washingtonianum*) found in the Umpqua Forest.



FIG. 120.—Old lava flow in the Cascade Forest. The bank in the background is the edge of an old flow that now supports vegetation. Some large trees are found on this old flow.

of each species observed, as it is influenced by its environment, and to discover the characters by which different but similar species may be distinguished.

By riding or walking day after day through meadows, forests, and plains, observing the cattle and sheep on the grazing areas, one learns the choice of stock as to the different species of grasses. Some species are eaten greedily; others are avoided or eaten only under the pressure of hunger.

A few years ago I described as new a species of mountain bluegrass sent in by a correspondent from southwestern Oregon. On this



FIG. 122.—Beargrass (*Xerophyllum tenax*), a conspicuous liliaceous plant with white flowers found in meadows and openings in July. Cascade Forest, Oregon. Summit of the Cascade range in the background.

trip I was able for the first time to observe this species in its native habitat. It is confined to a rather limited area but is abundant there.

Grasses grow under a great variety of conditions, forest, meadow, plain, marsh, rocky slopes, cliffs, alkali flats, seashore, even to the highest peaks except where covered by permanent snow. But in the main each species is confined to a definite set of environmental conditions.

Specimens of grasses were collected to record the observations made, the total number reaching some 200, representing about 100 different species. Common and well known species were not taken.

THE GRASSES OF CALIFORNIA

BY JASON R. SWALLEN

In order to investigate at first hand the melic grasses (*Melica*), an important genus on the Pacific coast, a field trip was made to California during the summer of 1927. At the same time, critical notes were made on other grasses which required detailed study. I first undertook a four-day trip across the Coast Range west of King City. At the lower altitudes the season was too far advanced for profitable study, but toward the summit the grasses were in the best of condition. Later I visited points of interest at San Luis Obispo, Santiago Peak in the Santa Ana Mountains, San Jacinto Peak, San Antonio Mountain, and Arrowhead Lake, the last in the San Bernardino Mountains. An interesting feature of San Jacinto Mountain is the presence near the summit of a small lake called Hidden Lake. Only a few steps from the edge of the lake one can look down the almost vertical side of the mountain upon Palm Springs and the Colorado Desert 10,000 feet below. Material of *Melica imperfecta* was especially good and abundant among the rocks on San Antonio Mountain. At Arrowhead Lake I found an annual fescue (*Festuca castwoodae*), which is very infrequent.

In the early part of July, 10 days were spent in investigating the grass flora of the King's River Canyon and the adjoining mountains. This necessitated a camping trip, and Sequoia National Park served as a starting point. I used a burro to carry camping equipment, which proved to be much more convenient than carrying a pack myself. Because of the beautiful scenery, this part of California has become more and more popular with tourists and campers, even though it is inaccessible except on foot or horseback. During the few days I spent on this trip I passed several groups of as many as 30 campers, accompanied by large pack trains.

On the floor of the canyon at this time of year it is quite hot and dry. The ground cover, composed to a large extent of annual grasses, was almost completely dried up except in a few low places near the river. As higher altitudes were reached, conditions became much better. On either side of the canyon the walls rise almost perpendicularly for thousands of feet, making a very impressive sight.



FIG. 123.—Giant wild-rye (*Elymus condensatus*). These plants are exceptional in the branched form of the panicles which are usually spikelike. Found growing in dry sandy soil in the valley east of the Santa Ana mountains. This species is characteristic of the hills of the Coast Range.



FIG. 124.—Scene on San Antonio mountain. Among the rocks to the left is a species of *Yucca*; *Melica imperfecta* was also plentiful here. The white streak on the mountain in the background is an area cleared by the Forest Service to prevent the spread of fire. Note the improved mountain road.

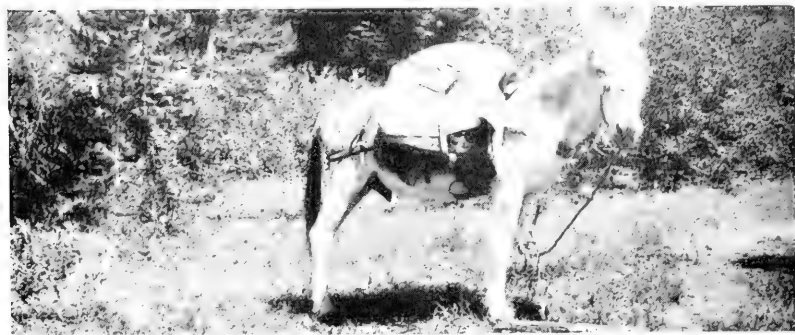


FIG. 125.—The burro used during the King's River trip. This trip was made on foot, the burro carrying a light camp outfit and collecting equipment.



FIG. 126.—Looking toward the King's River Canyon from Copper Creek trail to Granite Basin. Note the steep bare walls of the canyon. The floor of the canyon is much lower than can be seen in the picture.



FIG. 127.—Granite Basin, along the main trail north from King's River Canyon. The vegetation here is stunted, growing for the most part in crevices in the rocks. Note the effect of the wind on the tree in the foreground. Altitude 10,500 feet.

I made as complete a collection of grasses as possible, for there are but few collections from this region. The season was very backward at high altitudes owing to the unusually large amount of snow that fell during the past winter. Alpine work was, therefore, impossible, and especially was this true of Mount Lassen, which I visited early in August.



FIG. 128.—Scene just south of the main peak of Mt. Lassen, showing the large amount of snow still present the latter part of July. Altitude about 9,000 feet.

Other places included in the summer's work were the mountains above Huntington Lake in Fresno County, and those above Lake Tahoe in the vicinity of Twin and Ward Peaks. The mountains of California provide excellent opportunity either for natural history study or for recreation.

Over 500 specimens of California grasses were obtained during the summer.

ARCHAEOLOGICAL EXPEDITION TO CHINA

By C. W. BISHOP,

Associate Curator, Freer Gallery of Art

In a previous publication,¹ it has been made clear that the fundamental purpose of the Freer Gallery of Art in despatching a Field Expedition to China was not merely that of making collections, or even of conducting researches on its own sole responsibility. The aim, on the contrary, was to effect a definite and equitable arrangement with the Chinese authorities and scientific bodies themselves for the prosecution of archeological investigation on a closely cooperative basis. Their considered but cordial response to our overtures has amply demonstrated the wisdom of this policy and of its continuance.

Accompanied by my Chinese helper, Mr. K. Z. Tung, to whom is due much of the credit for our subsequent success, I arrived in Shanghai on March 17, 1923, and remained in the field, with the exception of one brief interval, until April 30, 1927. During this period of slightly over four years, close and very harmonious relations were established with the Historical Museum of Peking, to which, as previously stated,² I was before long appointed Honorary Adviser at the initiative of the Chinese Government, and also with the newly founded Research Institute of Tsing Hua University, better known to the American public as the "Boxer Indemnity College." Conjointly with representatives of one or other of these bodies, ten of the Eighteen Provinces of China, including all those of the greatest historical importance, were visited and studied, and actual excavations were conducted in three.

As part of this work has already been described in previous reports,³ it will not be further discussed here. To take up the account from the spring of 1925, that season was spent in northern Shansi, where, besides further study of the famous Buddhist sculptured caves of Yün Kang, a detailed exploration was made of a rather large area centering about the important city of Ta-t'ung. Many sites of great

¹ *Explorations and Field-Work of the Smithsonian Institution in 1924*, Smithsonian Misc. Coll., Vol. 77, No. 2, p. 75.

² *Loc. cit.*

³ *Loc. cit.* and *ibid.* for 1926.



FIG. 129.—Royal Tomb of the Northern Wei Dynasty (386-535 A. D.), near Ta-t'ung, northern Shansi.



FIG. 130.—Remnants of the Great Wall, near Ta-t'ung, northern Shansi.



FIG. 131.—Members of the Freer Gallery Expedition and the aeroplane in which explorations were conducted.



FIG. 132.—Excavations at Peitaiho; uncovering the ancient earthen wall of the fortified camp.

historical significance were noted, among them what seems in all probability to be that of the earlier capital of the Tartar dynasty known as the Northern Wei (A. D. 386-535). A visit was also paid to a region near the edge of the Mongolian plateau, where the Hiung-nu, identified with the Huns who later ravaged nearly the whole of Europe, are known to have held their great annual assemblies about the beginning of the Christian Era. Here were secured numerous bronze objects, arrow-heads, knives, ornaments, and the like, showing a decided Scythian or South-Siberian influence.

During the summer our attention was again devoted to the old fortified site on the rocky promontory of Lighthouse Point, at Peitaiho, on the Gulf of Chihli, mentioned in the report of our work for 1924.¹ Excavations here disclosed remains of at least three periods, a late Neolithic (prehistoric) occupation, a small but commanding Han Dynasty fortification of about the beginning of our Era, and a large entrenched camp apparently of the late Ming period, late 16th or early 17th century. An accurate large-scale survey of the site made by my associate, Mr. A. G. Wenley, who had come out to join me in August, 1923, and Mr. Jas. M. Menzies, formerly Licensed Land Surveyor for the Government of Canada, confirmed in an interesting manner the deductions I had drawn the previous summer from an inspection of the site from the air.

Early autumn found us once more in the northern Shansi area, where we remained until the advent of severe winter weather, coupled with local disturbances, put an end to all field activities. Shortly thereafter, Mr. Wenley left for Paris, where he has since been continuing his Sinological studies under Professor Paul Pelliot and others.

In the following spring, that of 1926, I paid a visit to Ningpo, in the region once occupied by the non-Chinese state of Yüeh during the Late Bronze Age, in the latter half of the 1st millennium B. C. The prevalence of banditry prevented the carrying on of my investigations on the scale originally planned; but enough was learned to demonstrate the importance of this area as a field for future intensive study.

Returning from Ningpo to Shanghai, I next proceeded up the Yangtse River with a view to investigating the remains of the old non-Chinese countries of Wu and Ch'u, formerly occupying the lower and middle portions of the great valley respectively, and which did not come under Chinese political domination until about the close of the 3rd century B. C.

Conditions in the former area, that once occupied by the kingdom of Wu, proved on the whole much like those prevailing in the delta

¹ *Loc. cit.*, p. 71.



FIG. 134.—The Lung Wang Tung ("Cave of the Dragon King"); near Ichang, in Hupch Province.



FIG. 133.—Mr. Wenley prospecting for prehistoric sites; northern Shansi.

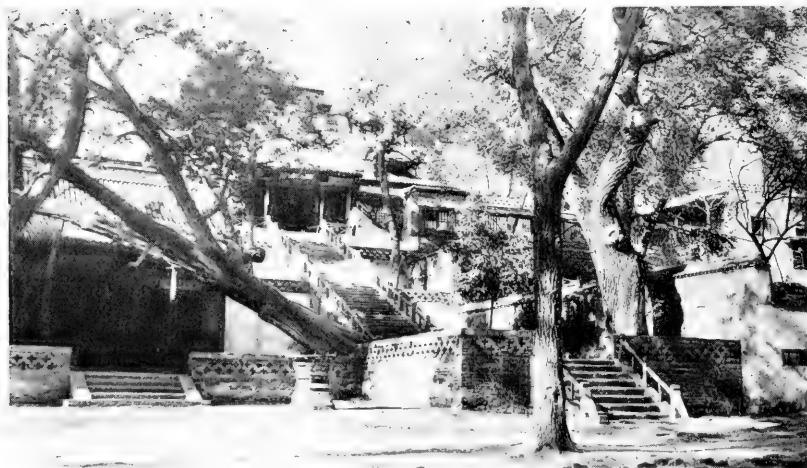


FIG. 135.—Chin Ssü Temple, near T'ai-yuan, Shansi Province; a corner of the court.



FIG. 136.—Scene of Dr. Chi Li's Work, near village of Hsi Yin Ts'un, in southwestern Shansi.

region of Egypt, and for the same reason. The shifting of the water-courses through the ages and the deposition of enormous amounts of silt render the prospect of successful excavation doubtful, save in a few elevated areas; but it is precisely the latter, rising above the wide-spreading marshes covering the region in ancient times, which formed the only available sites for habitation.

In ancient Ch'u, on the other hand, corresponding roughly to the modern provinces of Hupeh and Hunan, conditions are far otherwise. The ground is higher, and we found ancient city walls and foundation mounds numerous. Here again, disturbed political and military conditions rendered only a superficial examination possible, even that being conducted on one occasion under fire from a small group of irresponsible soldiers. Enough was done, however, to disclose innumerable remains of various periods, from prehistoric times downward, at or very near the surface, and highly suggestive of the rich rewards awaiting the systematic excavator.

Dr. Chi Li's report of his preliminary reconnaissance of the Fên River valley, in southwestern Shansi province, in the early spring of 1926, has already appeared.¹ While engaged in this task, Dr. Li contracted a severe case of typhus fever, always present in interior China, which lacked little of terminating fatally. In the autumn, his health being restored, he returned to the same area under the joint auspices of the Freer Gallery of Art and Tsing Hua University. The Geological Survey of China, with characteristic breadth of view, loaned us for this work one of its best men, Mr. Philip L. Yuan, a very capable cartographer and geologist with large experience in Chinese archeology.

Dr. Li, after reaching a highly satisfactory understanding with the authorities and winning the confidence of the local peasantry, began excavations on a late Stone Age village site of large dimensions, in the extreme southwestern portion of Shansi province. He continued his operations here until snow rendered excavation useless, and then returned to Peking with nearly 80 packing-cases of excavated material of all sorts. He is at this writing engaged in the preparation of a full report of his finds.

It was my original intention, while Dr. Li was working in Shansi, to devote myself to further work along the Yangtse River. The disorder and banditry prevailing in that region, however, made this out of the question. Consequently I put into execution my long deferred plan of exploring the province of Shansi throughout its entire length,

¹ *Explorations and Field-Work of the Smithsonian Institution in 1926*, Smithsonian Misc. Coll., Vol. 78, No. 7, pp. 123-137.



FIG. 137.—Entrance to the Yangtse Gorges, near Ichang, Hupeh Province; looking upstream.



FIG. 138.—Scene near Ningpo, in the region formerly occupied by the non-Chinese Kingdom of Yüeh during part of the First Millennium B. C.



FIG. 140.—The same; closer view of one of the sculptured caves.



FIG. 139.—T'ien Lung Shan ("Heavenly Dragon Mountains"); Buddhist cliff temples, central Shansi.

of about 500 miles by road. In this undertaking I was accompanied by Mr. Tung. We traveled by Ford motor-car, finding many sites new to science and securing a first-hand idea of the topography of the region highly important to a correct interpretation of the movements of man and the spread of civilization there in ancient times.

After visiting Dr. Li's work, I returned to the provincial capital, T'ai-yuan, where I had the privilege of being presented to T. R. H. the Crown Prince and Princess of Sweden, and of accompanying the former by motor-car to a Neolithic site some distance away, under the guidance of the eminent Swedish archeologist, Dr. J. G. Andersson. Then, continuing my journey, I traveled northward for 200 miles, crossing the Yün Chung Shan or "Midst of the Clouds" range of mountains by a pass of about 7,000 feet elevation, according to report. This chain long formed the ancient Chinese frontier against the northern barbarians, and along its foot to this day runs one of the Great Walls so numerous in that part of China.

By the beginning of 1927 it had become apparent that the large amount of material already gathered could be studied and reported on to far better advantage in Washington than in China. Moreover, the unsettled conditions almost universally existing in China rendered the prosecution of further field-work there for the present a matter of great uncertainty. I therefore arranged that Mr. Tung and Dr. Li should remain in Peking, to maintain the close relations which we had established with the leading Chinese scientific bodies and to do such field-work as might be possible. Our Peking headquarters were closed on April 30, and after visiting archeological sites and collections of importance in Korea, Japan, Egypt, and Europe, I arrived in Washington on August 6, 1927.

Thus, besides achieving the fundamental object for which it was sent out, *vis.*, that of reaching an understanding with the Chinese themselves for effective cooperation in archeological research, the Expedition has made a definite beginning in tracing out the development of civilization in several of the historically more important regions of China. The effort thus inaugurated, taken in conjunction with the growing collections of the Freer Gallery of Art and the steady acquisition of Chinese books by the Library of Congress, promises in time to make Washington a center of Chinese studies second to none. Further, owing to the ingrained respect for learning entertained by the Chinese people of all classes, the friendly contacts established by work such as ours provide one of the readiest means for promoting a better understanding and closer harmony between America and China.

INDIAN VILLAGE SITES AND QUARRIES IN TENNESSEE

By WALTER HOUGH,

Head Curator of Anthropology, U. S. National Museum

On the report of some recently exhumed burials at Indian Mound, Tennessee, brought to notice by Congressman Joseph W. Byrns, the Bureau of American Ethnology sent the writer to investigate. Indian Mound is a town named for a large mound in its midst. Owing to wear and tear, the mound has been much reduced from its original height. Recently several slab lined graves were carefully opened by Thomas W. Seay, Jr., and protected as exhibits. One piece of pottery, a polished fletcher and beads, and a few other artifacts were found.

The writer, under the guidance of Mr. Seay, visited several village sites and quarries in the vicinity of Indian Mound. Especially interesting was a site at Brinton Hill having a heavy deposit of broken flints and shells of *Campeloma* and *Pleurocera* from the Cumberland River, fresh water mollusks which do not exist in the stream now.

The Mississippian limestone, which is the characteristic rock of this region, is rich in flint. One great quarry on the Brigham place, near Dover, yields large blocks of homogeneous, liver-colored flint from which the aborigines struck the hoe blades 12 to 18 inches long typical of the Mississippi agricultural complex. On a field of Mr. Brigham's, chips and worked implements of this flint are found in enormous numbers. Other quarries were visited, but the quarry yielding a particularly fine blue flint was not located.

An important collection representing the types of usual worked flint implements in this region was gathered for the Museum. Examples of these are shown on figure 141.

A widespread interest in archeological relics is displayed by the people of this region. In general the land owners are averse to indiscriminate digging by curiosity hunters, and for this reason most of the numerous box graves are intact. On the other hand many fine specimens found on the surface have come into the possession of professional dealers in antiquities.

The Tennessee archeological field is very rich, and the State Archeologist, Mr. P. E. Cox, and others are doing much to maintain public interest in the antiquities of the State.

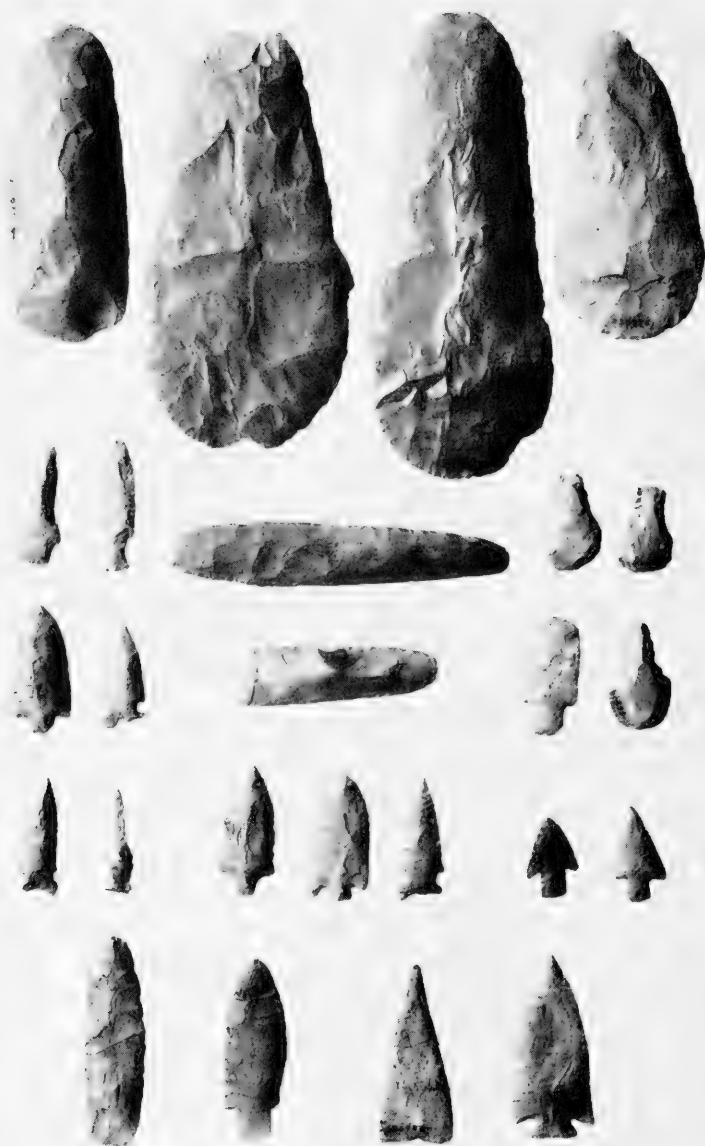


FIG. 141.—Types of chipped stone implements from Northwestern Tennessee.

FIELD STUDIES OF EARLY MAN IN EUROPE, 1927

By ALEŠ HRDLÍČKA,

Curator, Division of Physical Anthropology, U. S. National Museum

In the fall of 1927, the writer undertook a journey through Europe in the furtherance of his studies of Early Man. The principal objectives of the trip were: (1) A personal visit to some of the old as well as the more important recently discovered sites of Early Man; (2) the re-examination of a number of the skeletal remains of Early Man; and (3) a study of such of the Aurignacian skeletal remains as the writer has not been able to examine before. An additional object was the delivery of the Huxley Memorial Lecture before the Royal Anthropological Society of Great Britain.

The work began with the examination of the remains of Early Man preserved in the Museum d'Histoire Naturelle, Paris. Through the courtesy of Professor Marcellin Boule, the writer was able once more to see personally the originals of the La Chapelle, La Ferrassie, La Quina, and the two Aurignacian skeletons, which are preserved in that institution. From Paris the journey led to Périgueux, where careful re-examination and re-measurements were made of the controversial Chancelade skeleton. After a day at Les Eyzies, spent principally in consultations with M. Peyrony, the writer went to the south of France, where through the courtesy of the local guardians and Museum men, he secured valuable original data on the Aurignacian skeletons in the Museum of Monaco, and in the Museum and the Cave at Barma Grande, over the Italian border. The next stop was at Lyon, where thanks to Dr. Arcelin and Dr. Mayet the writer was able to examine the five lately discovered Aurignacian and post-Aurignacian skeletons, which have not yet been fully described. From Lyon the route led to Paris and then to Liège, where through the kindness of Professor Charles Fraipont and the brothers Lohest, it was possible to re-examine and take some additional measurements on the originals of the Spy skeletons.

From Liège the journey led to Düsseldorf and the highly interesting and beautiful Neander Valley which in 1856 gave us the original Neanderthal skeleton. The Neanderthal site has been neglected by anthropology. Since the discovery of the Neanderthal

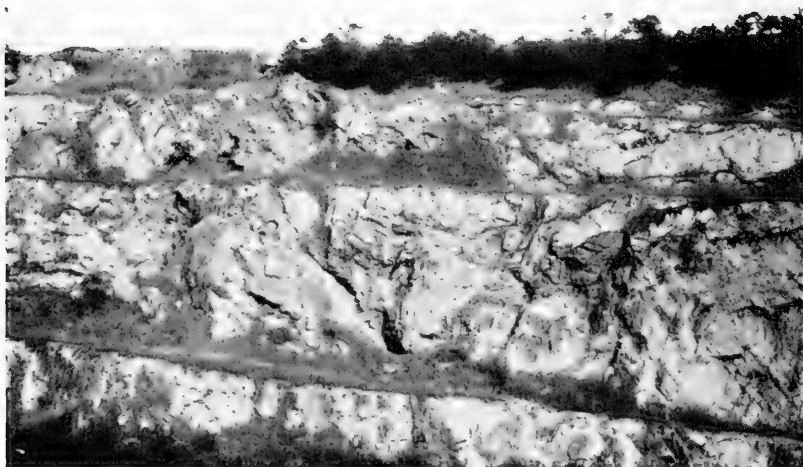


FIG. 142.—Neanderthal. The upper part of the right cliff, about where the cave that gave the Neanderthal Man, terminated. The holes seen in and near the center are said to be remnants of the large original cave. Below the cave is about 60 feet of rock and debris. New (present) finds are almost opposite across the valley, in loam lying just above the Devonian limestone.



FIG. 143.—A view across the Neander valley from the site of the old cave to the limestone cliffs just above which new discoveries of early cultural human remains are now being made.

skeleton in 1856, no serious explorations have ever been carried on there, and but few scientists have visited the spot. The valley is a limestone gorge cut by the small stream Düssel. It took its name from Joachim Neander, a song composer of the Reformed Church, who frequented the valley in 1674-79. In 1856, workmen engaged in quarrying the limestone uncovered an ancient and very primitive human skeleton, buried in the deposits of a cave. They tossed the bones and earth down the slope with the other refuse. Later the owner of the quarries, hearing of the find, asked that the bones be gathered. The workmen found 14 pieces of the skeleton and these were placed in the hands of Dr. Fuhlrott of Elberfeld, who eventually brought them to the notice of the scientific world.

Some prominent scientists of the day were inclined to look upon the low brow and the heavy supraorbital ridges of the skull, the thickness of the bones, as well as many other characters of anthropological inferiority, as evidences of an accidental monstrosity, or of a pathological condition. But gradually new examples of this same early type appeared in different parts of Europe, so that for a long time now science has been sure they represent a regular phase in the earlier evolution of man.

New finds of importance have recently been made in the Neander Valley. Paleolithic implements in conjunction with the fossilized bones of the mammoth and reindeer are now being found on the other side of the valley from the earlier discovery, at the base of the very thick layer of loam covering the limestone. So far the new site has not revealed any skeletal remains of man.

There is need for systematic research in the Neanderthal Valley. The rest of the original skeleton not recovered by the workmen after they threw it in the débris must still be there. With this may possibly be stone implements or fossil animal bones that were not noticed by the laborers. Vestiges of the limestone cave in which the original skeleton was found still exist (fig. 142) and ought to be searched for extensions and possible additional clues to early man. And new discoveries of the remains of early man in other as yet unexplored parts of the valley are quite probable.

From Neanderthal the writer went to Berlin, where he secured additional observations on the Le Moustier and the La Combe skeletons.

The journey then led to Prague where, at the invitation of the Czechoslovak Academy of Sciences and Arts, a lecture was given before the Academy on the "Ice Age and its Relation to Early Man." At Brno, the capital of Moravia, many of the new as well as older

discoveries relating to early man were examined, and from here an excursion was made in the company of Professor Karel Absolon, head of the Museum at Brno, to the new Aurignacian site at Viestonice, southern Moravia.

This site, discovered three years ago, appears to be vast and rich almost beyond estimation. It is located on the slopes of an isolated massif of hills and there is a possibility that it extends over the larger part of the slopes of these hills. It has already yielded over



FIG. 144.—A view down the Neander valley, right side, from near the site of the old cave.

300,000 flints and other human artifacts, tons of bones of the mammoth, and most recently also the first Aurignacian human skeleton. The government of Czechoslovakia is considering for the next year extensive soundings by which the extent of the site and its relative richness at different points may be determined.

From Moravia the writer returned once more to Paris, and thence to London and Oxford where he was able to examine additional ancient material, including the Rhodesian remains and the recently discovered second Gibraltar skull, and to visit various institutions.

The Huxley Lecture was given at the Royal Society, November 8, and on November 12, the writer sailed for America.

TINNE INDIANS OF THE LOWER YUKON RIVER VALLEY

By HERBERT W. KRIEGER,

Curator, Division of Ethnology, U. S. National Museum

The Yukon River, like all great streams located in remote parts of the world, never fails to excite one's interest and imagination. But little is known of the story of early human migrations that undoubtedly passed up or down its broad valley. At the suggestion of Doctor A. Hrdlička, and under the auspices of the National Academy of Sciences, excavations at certain archeological sites in the lower Yukon River valley were made during 1927. Investigations were carried on so far as conditions permitted at Shageluk, Holochakat, Anvik, and at Bonasila, an old village site 18 miles below the mouth of the Anvik River. The high stage of water during May and June did not permit completion of this work, so that another season might profitably be spent in conducting further archeological studies in the valley of the lower Yukon.

The site at Bonasila yielded skeletal material and cultural objects that indicate the early presence there of widely distinct ethnic groups. A curious contrast was observed in the types of implements recovered. Crudely fractured implements of schistose and shale rock, some of which had been used as knives, were slightly smoothed and beveled at the cutting edges but were otherwise unworked. There were also uncovered symmetrically shaped and highly polished nephrite celts such as are commonly fashioned by the Eskimo of northern Alaska. Jadeite adzes, Eskimoan in type, were found along with grooved, single and double bitted stone axes such as are occasionally found at various points along the Yukon, Koyukuk, and Susitna Rivers. Another contrast noted was that of carved objects of fossil ivory and of bone tools and stone weapon points. The ancient fossil ivory culture of north Alaska, of St. Lawrence and the lesser islands of Bering Sea is characterized by implements of fossil walrus ivory with beautifully scrolled and spiral surface etchings entirely distinct from the typical rectilinear and circle and dot etchings of the Eskimo. There are no realistic designs in silhouette etched on ivory as in the hunting and fishing delineations of the Eskimo of southwest Alaska.



FIG. 145.—The semisubterranean men's club, *kashim*, of Anvik, Alaska.



FIG. 146.—The modernized tunnel-like entrance to the men's club of Anvik. Formerly entrance might be obtained only by crawling on all fours.



FIG. 147.—A painted wooden grave box from Anvik illustrates how the occupant once caught a white whale in the Yukon.



FIG. 148.—Athapascan Indians of the lower Copper River preparing their catch of fish obtained with the fish wheel.



FIG. 149.—The spring break-up of the ice on the Tanana River at Nenana, Alaska.



FIG. 150.—Tinne Indians of the lower Yukon fishing with wires and traps through the ice of the Yukon.

The find of implements of fossil ivory with etched surface designs similar to early Siberian and north Alaskan types marks the site at Bonasila as the most advanced interior point known to have been reached by this culture.

Fragments of coarse black pottery were exhumed. These were decorated with rim hachure and were modeled like the heavy thick earthenware of the Eskimo. However, making of pottery by the Tinne Indians of the lower Yukon valley has been discontinued.

The art of painting, on wooden grave boxes, fishing or hunting scenes of special significance in the lives of the deceased is still occasionally practised. One of the grave box panels exhumed contains a realistic painting with black figures on a red background depicting the harpooning of a beluga or white whale. Another old panel from a wooden grave box at Bonasila shows in a spirited manner several reindeer running before a hunter.

The contrast in cultural objects emphasizing both Eskimo and Indian influences is complicated by the anomalous find of skeletal material which according to Doctor Hrdlička is dissimilar alike to Eskimo and Tinne physical types.

The valley of the lower Yukon below the mouths of the Anvik and Innoko Rivers was formerly Eskimo territory. A well defined trail extends from Anvik, up the Anvik River to the Eskimo village of Unalaklikmiut on Norton Sound near St. Michael. Another trail crosses the portage from the Kuskokwim to the Yukon River in the vicinity of Russian Mission. Eskimo formerly ascended these rivers beyond their present range of travel and there are many traditions of hostile encounters with Tinne Indians as far upstream as the confluence of the Koyukuk and Yukon Rivers. The environs of Shageluk Slough, east of Anvik, were formerly frequented by herds of caribou, whose presence there supplied a reason for the Eskimo advance to the interior. There is now a government herd of reindeer at Shageluk, thriving and increasing in numbers.

A brief study was made of the Tinne Indians of the villages of Anvik, Hologochakat, Shageluk, and other villages below the confluence at Fort Gibbon of the Tanana and Yukon Rivers. Many details of their ceremonial and religious life are similar to those of the Eskimo, the ceremonial masks and dances in particular being almost identical in appearance.

Indians of the lower Yukon gain a living primarily by fishing and hunting, but appear to be less energetic than the Tinne of the villages of Kaltag, Nulato, and Tanana farther upstream, who are primarily



FIG. 151.—Chief Luke, a Tanan native, in full regalia.

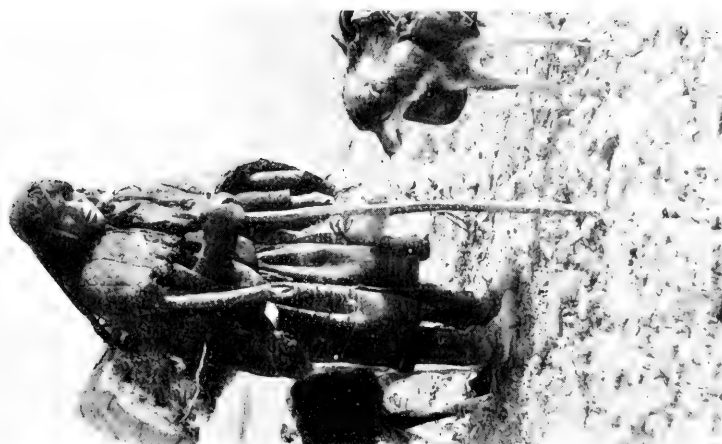


FIG. 152.—On the trail in the Copper River country.



FIG. 153.—A Time Indian of Anvik who resembles a Chinese type.

hunters. Yukon natives are great travelers. They think nothing of a 100 or 200 mile journey upstream or downstream. The same applies to trapping and hunting expeditions inland, but the final destination is always the river, either as a temporary camp or winter home. An Indian's trapping line may be 50 to 100 miles from his winter home, while his fish wheel and fish drying racks are always located at a distance from the winter village.

A successful season for the Yukon native nets him an income equivalent to that of many a city dweller within the United States. The Indian of the Yukon valley has adopted the civilization of the white man and now lives in a log cabin instead of the semisubterranean, earth covered pit house used by his ancestors. No difference was noted in the construction of the cabins of the Indians and of the white men. Log cabins with mossed chinks and moss covered overhanging roof are warm in winter but hot in summer. They are frequently infested with vermin and are dark, as many have no windows.

The modern Indian of the Yukon valley builds a small canoe of sawed boards after the model of the old birch bark canoe "*trich*" with its double overlapping strips of birch bark at the sides. A very few old canoes of birch bark survive. They were modeled according to the same principles as the kayak of the Eskimo and were covered over with birch bark at prow and stern with an opening large enough for only one person who operated the boat from a kneeling position at the center of the canoe. The Tinne make beautiful baskets of birch bark sewn with spruce roots around the margin, also coiled baskets of willow and grass with decorative panels in black, blue, and pink vegetable dyes.

The Yukon Indian still spears the lamprey eel and catches fish in traps through holes cut in the ice. The ice covering the Yukon in winter reaches a thickness of from three to five feet. In summer the native catches one or more tons of salmon in his fish wheel, dries them, and packs them in bales. The Indian woman stands the entire day at a fish rack cleaning the fish caught in the fish wheel. In preserving their catch of fish no salt is used, but smoking over a slow fire of green wood, grass, and moss is resorted to. Cured salmon are eaten dry and uncooked. The Yukon Indian prefers beef, whenever he can get it, to caribou meat as he says meat of wild animals has no strength. Sugar and tea are in great demand.

The *kashim* is an organization of the men of the village. A council of three under the leadership of the village shaman is the ruling body within the organization, whose visible incorporation is the



FIG. 154.—Chief Thomas of Nenana, Alaska, with his sled which is fastened together with sinew.

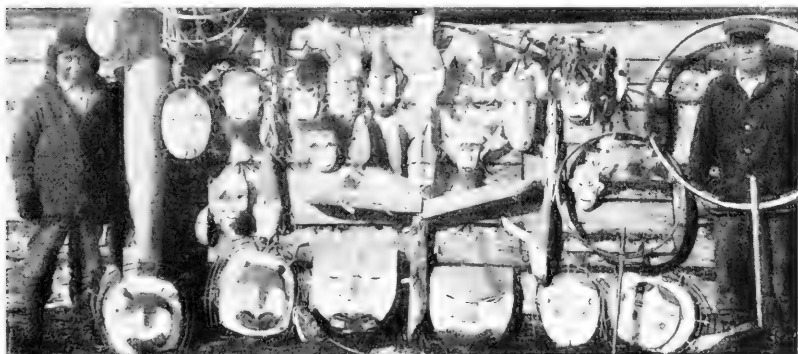


FIG. 155.—Every Alaska Indian knows that animals may take off their skin and assume human characteristics at will. Hence the resemblance of these animal and bird masks to human beings.



FIG. 156.—An improvised salmon curing rack with inverted birch bark canoe and fish trap in the foreground.

communal structure where the unmarried men of the village sleep. The *kashim* is used as a workshop by the men of the village in winter and during inclement weather, and by the entire community at the occasion of the frequent ceremonial dances. The roof is built of horizontally placed spruce logs reaching from one end of the structure to the other, a distance of 30 to 40 feet. The slope of the roof is quadrangular and converges toward the smoke hole at the apex. This is made possible by cutting each tier of roof beams shorter than



FIG. 157.—Rosario, the last of the pottery makers among the Timne Indians of the lower Yukon.



FIG. 158.—Timne Indian girl of Anvik whose attire represents a contrast of the new with the old. The bandeau and beaded pendants advertise her marriageability.

the tier of beams just beneath and by supporting it on a diagonal plate which rests on the two adjoining beams at each of the four converging corners. Over the entire structure is heaped earth, giving it a resemblance to the earth covered lodge of the Pawnee Indians of the United States. There are no windows, but at Anvik and other villages along the Yukon, the old smoke hole at the center of the roof has been glassed in, providing a cupola skylight. The *kashim* at Anvik is lighted with modern gasoline lamps, and is heated with a Yukon sheet iron stove.

PREHISTORIC INHABITANTS OF THE COLUMBIA RIVER VALLEY

BY HERBERT W. KRIEGER,

Curator, Division of Ethnology, U. S. National Museum

The tracing of early travel and migration routes in the Pacific Northwest is one of the most absorbing phases in the study of primitive American civilization. Archeological evidence of culture relationships that formerly existed between great groups of native Americans has been found in the upper plateau region, in the basin of the Columbia River in the states of Washington, Oregon, and Idaho. In recent years studies of these early cultural relationships have been made at various points in the valley of the Columbia by the Washington State Museum, the University of California, the American Museum of Natural History, and the Bureau of American Ethnology.

During the summer and early fall of the current year archeological investigations for the Bureau of American Ethnology were continued in the arid section of the Columbia Basin and in the valley of the Snake River. In 1926, the region extending from the mouth of the Yakima River to the Canadian border was explored. During the present season exploration of archeological sites was continued from the mouth of the Yakima River to Mosier, Oregon, in the vicinity of The Dalles. At this point an appreciable increase in rainfall and forest growth marks the dividing line between the humid northwest coast and the arid plateau of the interior.

Of the many objects uncovered, a small number were of value in distinguishing sub-culture areas, although in most essentials the early occupants of the upper plateau possessed a remarkably uniform culture. The sub-culture area of north central Oregon appears to be distinguished by the excellent chipping of weapon points and tools from obsidian, jasper, agate, and chalcedony. The sub-area of The Dalles and Miller Island, the so-called "Dalles culture," is characterized to a greater degree than is the sub-area of north central Oregon by realistically shaped animal and human figurines executed in stone and wood and appearing on wooden combs, stone pestle heads, stone bowls, and as stone plaques. The sub-area of The Dalles is also unique in the possession of a lozenge or ovoid-shape



FIG. 150.—A picture gallery from the Columbia River. On the basalt cliffs at Vantage, Kittitas County, Washington, may be recognized the carved figures of big horn sheep, Rocky Mountain goat, deer, and elk, but not of horse or bison.

stone knife with beveled lateral surfaces shaped by rubbing. This type of knife was found in abundance at Lyle, Washington. In the Snake River valley a form of bone or horn knife supplants the knife of chipped stone which prevails elsewhere in the Columbia Basin except in the areas mentioned.

The materials used as tools, or as media on which to execute art designs, are characteristic of very restricted localities and vary in many instances from village to village. The distinctions are the more clear cut, the more ancient the site and the more free the area from the influence of contiguous culture areas. It appears that the realistic carvings of the coast Chinook and Salish, executed for the most part in wood but also in stone, were copied by the tribes of the arid interior who used horn or stone as a medium. In such cases the more remote the village from the influence of the realistic coast art, the more frequently do geometric designs occur. Some Chinookan pieces were carried up the Columbia River, while objects made by the coast Salish found their way across the Cascades from Puget Sound and British Columbia. The presence of nephrite celts in burial offerings becomes less frequent the farther south one proceeds down the Columbia River. None was found by the writer below the confluence of the Yakima River.

The interior Salish tribes living in the valley of the Columbia north of Saddle Mountains were influenced by the coast Salish, communication being established through the Okanogan and Frazer River valleys and the intervening mountain passes to Puget Sound. The Shahaptian tribes were more directly influenced by the Chinook of the lower Columbia Valley and have consequently a superior command of realistic art designs principally of animal and human figurines in wood and horn. The so-called "Dalles culture" is nothing more than a modified coast culture.

Certain spots along the Columbia River were frequented by tribes from tributary rivers, such as the Willamette, John Day, Deschutes and others. These favored spots were near the falls or rapids of the Columbia or of some tributary stream. Here were caught and dried the salmon for the winter food supply. Here, also, was carried on trade in hemp, dentalium shell (the wampum of the west), blankets, and other native products, as well as in white man's trade goods obtained from trading posts. From the Shoshonean tribes on the east and from the Nez Percé Indians in Idaho came native products such as tanned bison skins, tailored costumes, elbow pipes and ornaments, while from the north came nephrite celts and an occasional decorated northwest coast pipe.



FIG. 160.—The canyon of the Snake River in Idaho. South of Lewiston the gorge reaches a depth of nearly one mile.



FIG. 161.—The falls and rapids of the Deschutes River near its confluence with the Columbia where, according to early accounts, was the greatest native trading center in the Columbia Valley.



FIG. 162.—Engraved dentalium shells exhumed from an ancient Wanapum Indian grave at Wahluke, Grant County, Washington.



FIG. 163.—An example of stone sculpturing characteristic of The Dalles culture of north central Oregon.

At Page, Washington, on the Snake River about 20 miles from Pasco, were noted definite departures from the general type of archeological remains characteristic of the sites along the Columbia River. No copper ornaments or other objects of metal were found; nor were any objects uncovered, other than dentalium shell, that might indicate intercourse with British Columbia or with the tribes of the lower Columbia. Bone knives and scrapers here displaced those of chipped stone; weaving implements and perforators were of antler or bone instead of chipped or rubbed stone as on the Columbia. Pairs of sandstone arrowshaft rasps; fine-grained, grooved stone polishers; basketry fragments, showing styles of false embroidery, lattice weave, and simple twining; ovoid stone war clubs; and burials either with red paint or of the usual cremation group type—all these characteristics indicate a sub-culture area transitional between the Shoshoni on the east and south and the Shahaptian tribes of the middle Columbia Basin.

A unique object exhumed from the cremation burial at Page is a projectile weapon resembling a lance or atlatl head. The blade point is of chipped jasper; the shaft is a stem of charred wood eight and one-half inches long which tapers from a diameter of three-fourths inch at the nocked base to less than one-half inch at the broken nock end. A groove one-eighth of an inch deep and of equal width extends the length of the shaft. The find of an atlatl among the burial offerings at Page marks the first known occurrence of this projectile weapon within the area of the upper plateau. The atlatl dart is identical with that described and figured by Kidder and Guernsey¹ from the San Juan district in northeastern Arizona.

Native rock sculpture is of great interest although its significance is often obscure. It is usually possible to correlate rock inscriptions or pictographs with types of culture objects exhumed in cemeteries or village sites within the area near by. In such cases the finding of petroglyphs or pictographs becomes a key as to what objects of an archeological nature one may expect to find in the vicinity. Realistic animal figures carved on the basalt cliffs at Spearfish, Washington, and at The Dalles, Oregon, are similar to the animal figurines carved in wood and horn by the Indian tribes of the lower Columbia and of Puget Sound. Rock inscriptions at Roosevelt, Washington, except for one maze-like inscription covering several square feet of rock surface, are nondescript and have apparently little value as an archeological key; while the paintings on the cliffs of the John Day

¹ "Archeological Explorations in Northeastern Arizona," *Bull. 65, Bur. Amer. Ethnol.*, p. 182; also plate 84 (18).



FIG. 166.—Animal, human and symbolical figures carved on the columnar basalt at Vantage, Kittitas County, Washington.



FIG. 165.—Human dancing figures from the Snake River canyon south of Lewiston, Idaho.



FIG. 164.—Animal figure carvings from Spearfish, Washington near The Dalles.

TYPES OF NATIVE CARVING FROM THE UPPER PLATEAU.

River are again typical of the area and remind one of the animal figures etched in silhouette on the columnar basalt bluffs of the Columbia River at Vantage Ferry, Kittitas County, Washington. Inscriptions on the escarpment of the Snake River at various points, as at Central Ferry, at Almota, at the mouth of the Alpawa River, in Washington, and at Nampa and Pocatello, in Idaho, are characteristic of the art designs of the area in which they occur and differ markedly from rock inscriptions elsewhere.

The unique inscriptions, human figurine and animal figure rock sculptures, and paintings of the bison, at Buffalo Rock, about 20 miles south of Lewiston, Idaho, on the east bank of the Snake River

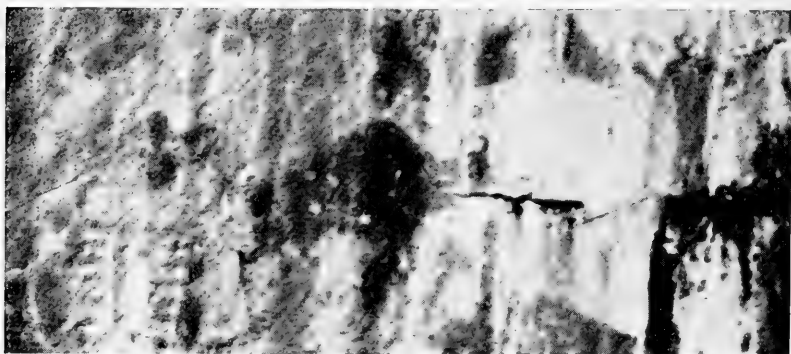


FIG. 167.—Figures of bison painted in red on a basalt rock 20 miles south of Lewiston, Idaho.

differ radically from other nearby inscriptions and are not characteristic of the petroglyphs or pictographs of central Idaho. They resemble much more what one might expect to find in a typical Basket Maker environment. It is possible that future investigations will reveal the presence in the Snake River valley of other evidence of a similar nature.

The type of early culture that existed within the arid sections of the Columbia Basin is definitely established. Many of the connecting culture and trade relationships are known. The relationship with the Shoshoni and with the cultures on the south, those of the Basket Maker and the Pueblo, is not yet clearly defined. Further research along the Snake River and in southern Idaho will no doubt bring out additional evidence of relationships with the pre-agricultural peoples of the southwest.

PREHISTORIC PUEBLO BONITO, NEW MEXICO

By NEIL M. JUDD,

Curator, Division of American Archaeology, U. S. National Museum

Since 1920, annual explorations¹ have been pursued under the auspices of the National Geographic Society in Pueblo Bonito, at once the largest, oldest and most important of the 17 major ruins comprising Chaco Canyon National Monument, northwestern New Mexico. These annual explorations, which I have had the pleasure of directing, are now concluded and preparation of the final reports recording the observations made is well under way.

Pueblo Bonito is not only the most important ruin in Chaco Canyon but it is, perhaps, the most important structure of its period in the entire Southwest. No other Pueblo village of pre-Spanish times so far as we are aware exhibits in equal degree the high development in civic organization, in architecture and the lesser cultural arts, so evident at Pueblo Bonito. Here is represented the very acme of prehistoric Pueblo civilization. Here are the crumbling walls of a vast communal settlement—an aboriginal apartment house—whose 500 or more connecting rooms, arranged in four terraced stories, sheltered no less than 1,200 individuals. These were farmers, tillers of the desert soil; their wide-spreading fields of corn, beans, and squash were watered by spring and mid-summer floods that poured off the bordering cliffs to be caught and diverted through man-made channels to areas of cultivation. But in time these fertile lands were rendered barren through thoughtless sacrifice of neighboring, limited forests to the ambitious building programs of the villagers. With the forest growth felled, arroyos formed; fields were destroyed. Our archeological evidence tends to show that altered geophysical conditions in Chaco Canyon was one of two major factors contributing to the gradual decline of Pueblo Bonito and its final abandonment approximately 1,000 years ago.

The Pueblo Bonito explorations of the National Geographic Society were brought to an end in 1926 and the season which followed was devoted wholly to preparation of the writer's final reports. But occasional opportunity was found for re-examination of the canyon walls and the table lands that stretch north and south from the Rio

¹ Smithsonian Misc. Coll., Vol. 72, Nos. 6 & 15; Vol. 74, No. 5; Vol. 76, No. 10; Vol. 77, No. 2; Vol. 78, Nos. 1 & 7.



FIG. 168.—Pueblo Bonito as it appeared in 1920, at the beginning of the National Geographic Society's explorations. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)



FIG. 169.—Excavation of Pueblo Bonito was concluded in 1924, but the two following seasons were devoted to study of earlier walls beneath the house group and its related court levels. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)



FIG. 170.—Three shallow basins, pecked from solid sandstone, occupy the middle of this circular, stone-enclosed area on the cliff above Pueblo Bonito. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 171.—Among Chaco Canyon's archeological puzzles are terraces formed by massive retaining walls, one of which is here partially shown. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

Chaco. The handiwork of ancient man, his indefatigable energy, is evidenced on every hand. Stairways, massive walls, "roadways" and divergent channels for irrigation are to be found in every section of the canyon. And much of this ancient work is inexplicable to us now; much represents a colossal and seemingly useless expenditure of human labor.

Local works related to prehistoric agriculture are, unfortunately, not at once apparent in this 20th Century. Chaco Canyon has changed since Bonitian farmers scratched its clayey soil with their crude digging sticks and sought to insure more bountiful crops through dramatic ceremonials and the planting of feathered prayer plumes to gods who control the rains. Fields once cultivated now lie buried beneath several feet of silty deposits, washed down from upper levels and spread uniformly across the valley floor. With concealment of these acres, time has also hidden from view those divergent channels the ancients constructed. But here and there, newly formed arroyos have cross-sectioned such a channel and perhaps disclosed the slab-stones or the imprint of its wickerwork re-enforcements.

What the Navaho refer to as "roadways" offer an entirely different problem. Imaginative Indians describe these cleared paths and expound at length upon the use to which they were put in ancient times, but the more conservative and trustworthy individuals, like old Hosteen Beyal, frankly admit that although they look like roads their makers could not possibly have intended them for use as such. Our southwestern aborigines had no beasts of burden, excepting dogs, and no wheeled vehicles prior to advent of the Spaniards in 1540. What function then did these "roadways" serve?

Two seemingly reasonable explanations come to mind: They were utilized either by religious processions passing from one community to another at stated intervals or they were prepared for the easier transportation of large timbers required in house construction. The latter appears to me the more plausible explanation. Within the historic period, Pueblo peoples are not known to have sent to neighboring villages messengers on recurrent ceremonial missions of such significance as to warrant prior construction of a special pathway; supposedly, no such necessity existed in prehistoric times. But a "road" would both expedite and facilitate the transportation of logs. Thousands of them were utilized in roofing the rooms of Pueblo Bonito alone; a newly felled pine is no light burden even for a dozen men. Since the need for beams was fairly constant, the Chacoans may well have anticipated the difficulties involved and lessened them somewhat by preparing the "roadways" under consideration. All



FIG. 172.—Loose stones were rolled to one side, forming this prehistoric "road" in Chaco Canyon. On the skyline, above the Indian, appear the ruins of New and Old Alto. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 173.—This yellow pine, felled during the winter of 1926-7, was the last of its kind visible from Pueblo Bonito. Tents of the National Geographic camp show in the middle left distance. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 174.—A pecked groove, of unknown import, on the ancient "roadway" southeast of Pueblo Alto. The distant figure stands on a related step series. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 175.—Between these two figures lie the much weathered stairs shown in the illustration above. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 177.—This stairway north of Chetro Kettle, described and figured by W. H. Jackson in 1877, was cut after abandonment of the more precipitous, incipient stairs at the upper right. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 176.—Hosteen Beyer, nonagenarian, who last summer recalled the verdant meadows and cottonwoods he knew in Chaco Canyon eighty-three years ago and following. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

this, of course, is purely speculative. Positive proof is lacking. Yet it is significant that these so-called "roads," traceable on both sides of Chaco Canyon, often lead from near a major ruin back across the mesas to another ruin or to some rocky ridge or rincon where pine trees doubtless grew in former times.

Pecked stairs occur wherever such a "road" crosses a natural terrace or ledge. Frequently these obstacles are so insignificant, comparatively, as to raise a question as to the necessity for steps, especially steps from 5 to 18 feet in width. I have seen Navaho drive their wagons with little hesitation over far rougher places. Yet, with rude stone hammers, the prehistoric Chacoans cut these stairs from solid sandstone to provide surer footing for their sandaled feet. No uncertainty exists on this score.

On the mesa north of Pueblo Bonito is a vast mound of fallen masonry known as old Pueblo Alto. Some 200 yards south of the ruin, a step series leads downward to connect with a "roadway" extending southeasterly more than a mile to the rim of Chaco Canyon where a stairway, now almost wholly obliterated through weathering processes, descends into the canyon. For a considerable distance this "road" is recognizable by the retaining wall on its lower side; in one place, it bisects a rounded knoll. Across bare sandstone, occupying the approximate middle of the "road," a pecked groove follows the irregular surface to lose itself under drifted sand and to reappear again and again. Its true significance remains unknown; we have observed no similar groove in connection with other ancient "roads" in Chaco Canyon.

Below the mesa top, half a mile northwest of Pueblo Bonito, and on the west side of the rincon north of Chetro Kettle are long terraces whose massive masonry, roughly laid, slopes upward and toward the cliff. These, too, are known to the Indians as roads but they lead nowhere. Each is barred by colossal sandstone blocks; cliffs crowd in at one side. Neither shows trace of former buildings nor indication of agriculture. In both cases the filled and fairly level area resulting seems wholly inadequate for any purpose commensurate with the labor each terrace represents.

Throughout the Chaco Canyon region successive generations of prehistoric men have left their finger prints to mark a slow but certain progress from a primitive, semi-nomadic mode of life to that highly organized social state evidenced by Pueblo Bonito and its neighboring ruins. But not all the diversified achievements of these ancient folk are interpretable from the fragmentary record we have inherited.

THE ESKIMO OF WESTERN ALASKA

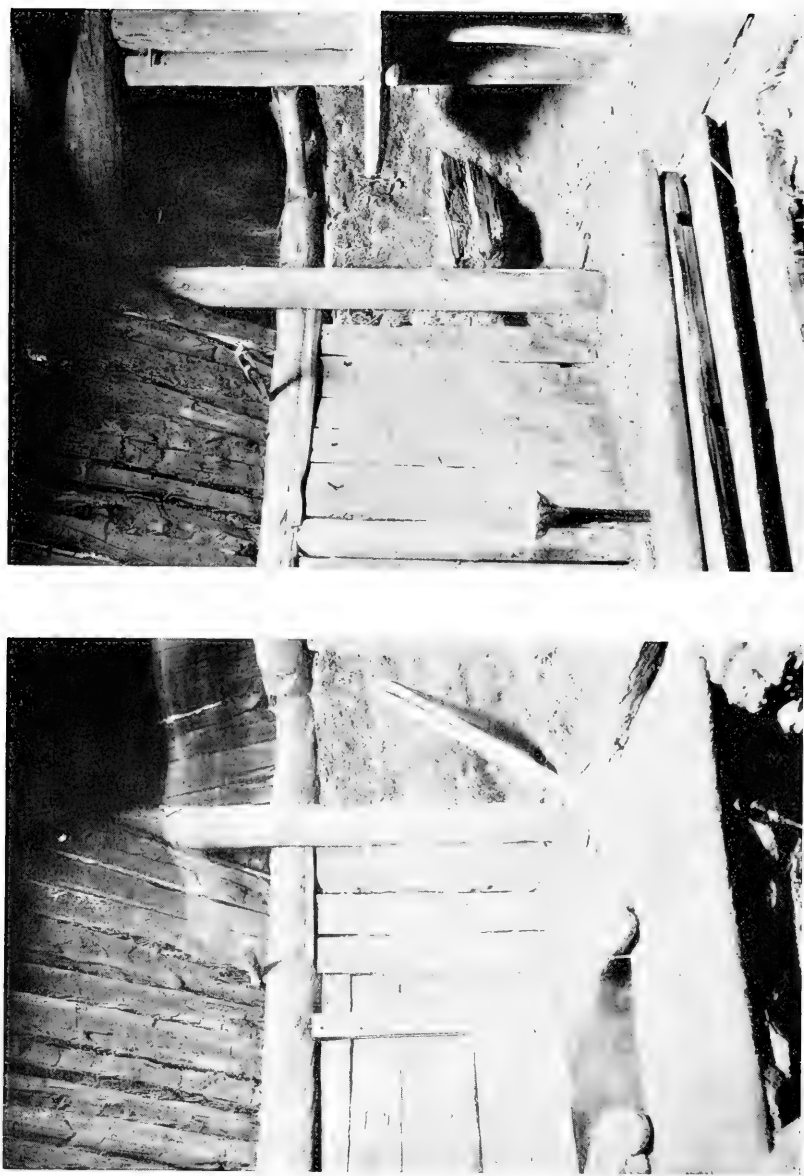
BY HENRY B. COLLINS, JR.,

Assistant Curator, Division of Ethnology, U. S. National Museum

From the standpoint of the anthropologist, the section of Alaska, from Bristol Bay northward along the coast to the mouth of the Yukon, is one of much interest, for here dwell the most primitive group of Eskimo to be found in all of Alaska. The region is bleak and dreary in the extreme, consisting for the most part of vast stretches of flat monotonous tundra broken in places by low mountains which extend to the coast and stand out as bold capes and headlands. The Bering Sea is here very shallow and frequently stormy, making navigation difficult. There are hardly more than a dozen white people in this entire region and no industrial or commercial activity of any kind, hence it is seldom visited by ships from the outside. Due to their isolated position the Eskimo here have retained more of the essential features of their native culture than those of any other part of Alaska.

For the purpose of observing these people, their manner of life and their physical type, as well as to collect skeletal and cultural material from inhabited and abandoned villages, the writer and Mr. T. Dale Stewart, of the Division of Physical Anthropology, U. S. National Museum, were detailed to conduct field-work along the coast of western Alaska, including the island of Nunivak, in continuation of the anthropological survey of northern and central Alaska made by Dr. Aleš Hrdlička in the summer of 1926. The work was conducted under the auspices of the Bureau of American Ethnology, the U. S. National Museum, the American Association for the Advancement of Science, and the American Council of Learned Societies.

We were fortunate in obtaining transportation to Nunivak Island on the U. S. S. *Boxer*, operated by the Federal Bureau of Education in the interest of the native schools it maintains throughout Alaska. The *Boxer* stopped at Unalaska, Akutan, and Ugashik on the Aleutian Islands and the Alaska Peninsula, and later at Kanakanak on the upper part of Bristol Bay. Here the Bureau of Education has established an orphanage and hospital and is doing a splendid work in educating and supporting the native children whose parents have died during the repeated influenza epidemics of recent years. Thanks



FIGS. 178 AND 179.—Views of the interior, front and rear, of a *kushge*, men's ceremonial house, on Nunivak Island. At left is the tunnel-like entrance, which in some instances opens also into the large fire pit, shown in the foreground and covered over with planks. Just back of the fire pit stands a wooden support for holding the seal oil lamp. (Photograph by Stewart.)



FIG. 180.—Eskimo children at Nash Harbor, Nunivak Island. When the Bureau of Education school was established here 5 years ago not a native on the Island spoke English. Today the children at Nash Harbor not only speak very good English but delight in singing songs and reciting poetry in their new language. (Photograph by Collins.)



FIG. 181.—Eskimo man at Nash Harbor wringing out seal skins to dry. From these will be cut the fish lines and fish and seal nets with which the Eskimos catch cod, salmon, and seal. (Photograph by Collins.)

to the willing cooperation of the Bureau representatives, we were able to obtain measurements on the full blood children, 42 in number, and in addition to investigate some of the nearby sites of old settlements.

Leaving Bristol Bay we continued northward along the coast, stopping at Kulukak, Togiak, Mumtrak, and Tanunuk. The Eskimo here live in small villages, usually along the coast near the mouth of a stream. They subsist principally on fish, seal, and birds, together with berries and a few other native plants. The most important item of their clothing is the inevitable parka, a long coat-like garment made of feathers or fur. Their dwellings are semi-subterranean, consisting of a square or octagonal excavation from one to three feet deep with walls and roof built up of successive tiers of driftwood logs, for there is no timber anywhere along the coast north of Bristol Bay. The outside is completely covered with sod on which in summer there is growing grass, giving to the house more the appearance of a small mound than a dwelling. The houses are entered through a small ante-chamber, connected with the main room by a narrow tunnel-like passage. A characteristic feature of these Eskimo villages is the kashim, or kuzhge, where the men and boys spend the greater part of their time and where the dances and winter ceremonies are held. The kashim is larger than the women's house and in construction differs from it in several respects. For winter travel the Eskimo use sleds and dog teams while in summer most of their journeys are made in the kayak, the ingeniously made skin boat so typical of the Eskimo everywhere. The kayak has a light frame of drift-wood tightly lashed together with leather thongs and covered over with seal skin. A round opening is left at the center just large enough to hold two people sitting back to back. In front of the paddler, resting on ivory pegs along the sloping top of the kayak, are laid the harpoon, bird spears, and throwing stick, but in addition to these native weapons of the chase, the Eskimo of today usually has a rifle or shotgun stowed away inside the kayak.

On June 21st we landed at Nash Harbor on the northwestern end of Nunivak Island, 48 days after leaving Seattle. Here at the small native village of Kligachimiuny is located the Bureau school under the able management of Mr. and Mrs. Irving H. Bird. Shortly after our arrival at Nash Harbor, our party was increased to three by the arrival of Mr. C. G. Harrold, Canadian ornithologist, who was collecting for the California Academy of Sciences.



FIG. 182.—Cape Etolin, northeast end of Nunivak Island, one of the two small sections of the Island that are charted. This narrow peninsula, part of which becomes an island at high tide, has its rocky surface partially covered by sand dunes, on which in summer there is a rank growth of grass. (Photograph by Collins.)

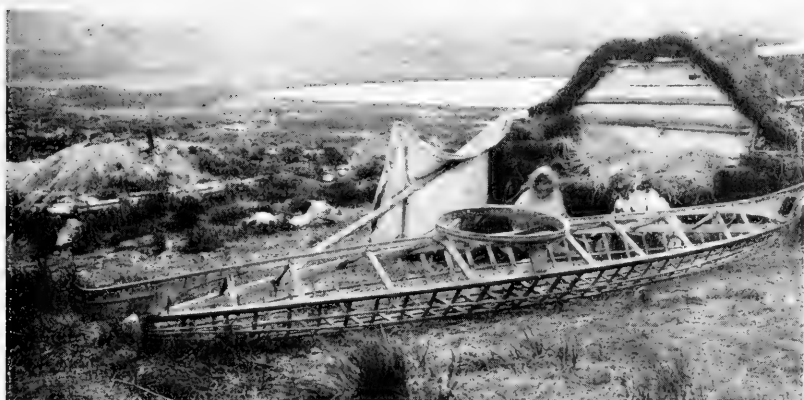


FIG. 183.—Nash Harbor, Nunivak Island: Miwolka and his wife patching up the seal skin covering to his kayak. This type of kayak is typical of the greater part of west and southwestern Alaska. (Photograph by Collins.)



FIG. 184.—C. G. Harrold standing in entrance of deserted house on Nunivak Island. (Photograph by Stewart.)



FIG. 185.—Rock enclosed burials at deserted village, southwest end of Nunivak Island. Rock vaults exactly similar to these were also found to contain seal burials. (Photograph by Stewart.)

Nunivak Island is 70 miles long and about 45 miles wide, but there are no dependable charts of its shores except for two restricted localities. The eastern and central parts of the island are rather flat except for a few isolated mountains of no great height. To the west, however, there is a gradual rise and the shore line is rugged and precipitous.

While very little was definitely known of them, the Nunivak Eskimo have long been regarded as the most primitive in this remote region. This we found to be true. Women were found still wearing the lip, ear and nose ornaments of beads and walrus ivory that were given up years ago by the other Eskimo of western Alaska. The elaborate observances and ceremonies relating to the hunting of the seal and their social and religious life in general, furnish additional evidence of the extreme conservatism of these people.

Our first work at Nash Harbor was to take measurements and physiological observations on the natives. We then explored on foot much of the western end of the Island, collecting bones and ethnological material from several deserted villages and finally from the village at Nash Harbor. Having completed the work at the western end of Nunivak, we moved on to Amolowikimiut, a native village at Cape Etolin some thirty miles to the east. Work here was continued as before, and was greatly facilitated by the intelligent cooperation of Mr. Paul Ivanoff, the native trader.

In August we left Nunivak, Mr. Stewart going to St. Michael with the trader from Tanunuk village, Nelson Island, while I followed shortly afterwards with the Ivanoff family. A stop was made at Hooper Bay, a very interesting Eskimo village on the mainland between Nunivak and the Yukon, and additional collections and anthropometric data were secured. From St. Michael the outward trip was made up the Yukon to Nenana, and thence to the coast to Seward, affording an opportunity to observe the Eskimo along the lower Yukon and later the Athapascan Indians further up the river.

As a result of the summer's work there were collected several hundred skulls with numerous skeletons, while measurements were taken of some 180 living Eskimo. The measurements on the living are the first to be made in western Alaska, and these together with the skeletal remains will furnish the first adequate knowledge of the physical type of this little known region.

It would be impossible to mention the names of all to whom we are indebted for assistance. Particular thanks, however, are due to Dr. William Hamilton of the Alaska Division of the Bureau of Education, Washington, D. C.; Mr. Jonathan H. Wagner, Chief of the

Division, Seattle; Mr. Carl Lomen of Nome and New York; Mr. E. S. Curtis of Los Angeles; Capt. S. T. L. Whitlam and the crew of the *Boxer*; Mr. E. J. Beck, Superintendent, Southwestern District, Bureau of Education; Dr. Charles Firestone and others of the orphanage and hospital staff at Kanakanak; Mr. Paul Ivanoff, Nunivak Island; and Mr. and Mrs. Irving H. Bird, Mr. and Mrs. Leo W. Schrammeck, Mr. and Mrs. Glenn Hall, and Mr. and Mrs. Mischa Ivanoff, teachers at the various schools.

THE ARCHEOLOGY OF THE PIEDMONT REGION OF SOUTH CAROLINA

By J. WALTER FEWKES,
Chief, Bureau of American Ethnology

The eastern horizon or boundary of the Mound Builder Culture of eastern North America has been very little investigated by archeologists and, in spite of the fact that it presents instructive local variations, the character of that portion of it which extended east of the Blue Ridge is but slightly known. The archeology of South Carolina has a very limited bibliography, few contributions having been made during the present century, although the aboriginal tribes of the State were interesting and important. However, one or two local collections not reproduced in any publication indicate that this is a promising area for the field worker. I was induced to visit the Piedmont area of this State in the summer of 1927 by letters from the owner of one of these collections, Mr. W. J. Thackston of Greenville, and the results of my preliminary investigations are here given. Mr. Thackston called my attention to several other collections made by residents of Greenville and was instrumental in obtaining permission for me to study and photograph them and describe them in print. He accompanied me on excursions to study and compare the mounds and other major antiquities of the region, but no excavations were undertaken, such work being postponed until a time when more money would be available.

The majority of the objects here shown are in the very valuable collection of Mr. Charles F. Schwing of Greenville, who afforded me every opportunity to study his specimens and publish a preliminary description of them, and I take this occasion to thank him and Mr. Thackston, as well as many others who expressed the greatest interest in the investigations and aided me in the work. In fact the kindness shown me on this visit made this one of the happiest months of the many I have spent in archeological research. I returned to Washington in the closing days of the fiscal year with a strong desire to continue my explorations at this point and pursue them at other places east of the Alleghanies.

A fact that impressed me very strongly was that, while valuable collections had been made in the Piedmont section, there is as yet no attempt to correlate this material with corresponding material from

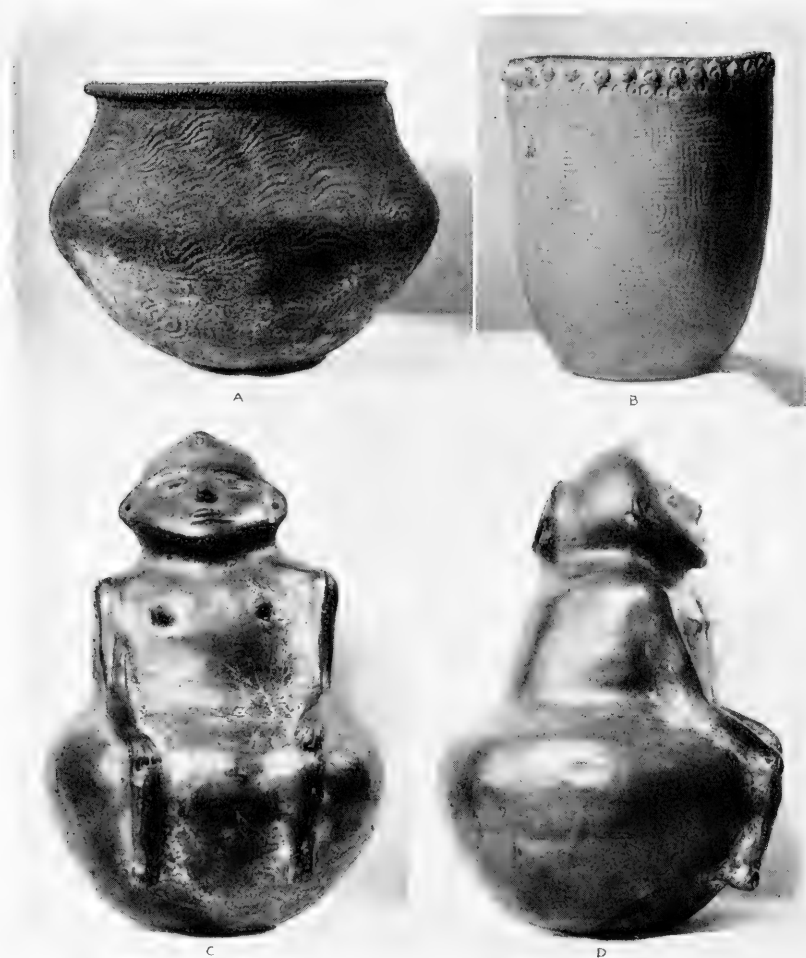


FIG. 186.—*A*, Bowl with stamped decorations; *B*, bowl with stamped decorations and circles around the rim; *C*, *D*, front and side views of effigy bowl from bank of Savannah river. (Schwing Collection.) Similar to specimens from middle Mississippi valley described by Holmes.



A



B



C

FIG. 187.—*A*, Rectangular, flat-bottomed dishes with four legs and incised decorations (Hertzog Collection); *B*, *C*, bowls with incised external decorations, found in the Catawba country. The motives on *B* represent parts of the Great Plumed Serpent. (Thackston Collection.)

the adjacent archeological culture areas. It would be highly desirable, therefore, not only to gather more artifacts and locate more prehistoric sites east of the Blue Ridge but also to determine the relationship of the Indians of this territory to other Mound Builders. The prehistoric pipes and pottery contained in the above collections are characteristic of the southern Mound Builders, particularly those of the Gulf region. Their closest counterparts occur in the mounds of Arkansas and Missouri. As a rule the pottery is not as varied as that of the Pueblo Indians, mainly because none of it is painted. The common types of vessels are unglazed globular food bowls with decorations stamped in. Although the material thus far collected may not be sufficient to enable the archeologist to determine the tribe to which its makers belonged, it is probably akin to the productions of the Cherokee or some Indians of the Muskogean stock.

The human effigy vase shown in figure 186, *C* and *D*, is thought to belong to the Middle Mississippi group, several specimens of which were figured by Prof. Holmes (20th Ann. Rep., Bur. Amer. Ethnol.). This one is of the same general character as others found in sites near the eastern and western boundaries of the Middle Mississippi group but rarely at intermediate points. It has passed through several hands, but the story of its discovery is so definite that there appears to be no reason to doubt it. According to this, it was picked up by a boy at the foot of a low cliff on the left bank of Savannah River not far from Augusta. The cliff had no doubt been occupied by Indians and the vase washed out of it by the river. I was not able to visit the locality myself but quote reliable informants. So far as I am aware, this human effigy vase is the only one of its type ever obtained from the Piedmont region of South Carolina. There is no record of anything of the kind from the Ohio Valley mounds or mounds on the Gulf coast, but Prof. Holmes has figured many from Arkansas. The two spherical bowls in figure 186, *A* and *B*, bear incised designs formed by stamping. They are almost identical with similar objects from Weeden Mound near St. Petersburg, Florida, but their marginal decorations are different from those with which I am familiar on all stamped ware from that State. The row of raised rings on the outer margin of *B* is an exceptional feature that has never been noted on Mound Builder pottery of the stamped variety.

In figure 187, *B* and *C*, are represented two beautiful globular bowls in the Thackston collection, supposed to be ancient Catawba ware. It is reported that they were found near Catawba River, and thus there is some support for the identification, but modern Catawba ware differs considerably. Several tribes allied to the Catawba formerly



FIG. 188.—Pipes. *A*, Monitor pipe of stone, from side; *B*, stone monitor pipe with flat stem; *C*, unfinished bird pipe of stone with stem unperforated; *D*, lower surface of stone monitor pipe; *E*, bird pipe with representation of human face in relief on one side of the stem; *F*, clay pipe with conical bowl in mouth of wolf. (Schwing Collection.)

lived in western South Carolina, but, until we have established the characteristic pottery of each, it is not possible to refer the specimens figured here to any one of them. Bowl *C* of the above figure has a simple ring of incised dots equatorially placed, and *B* has an original design of considerable complication covering the whole exterior. It consists of incised grooves so arranged as to indicate several figures which are partly decorative and partly conventionalized. The circle with tripointed figure, shown at the left, is also found repeatedly, in combination with serpent designs, in the decoration of Mound Builder pottery. In several figures snake symbols may easily be traced. It would appear that this vessel was used in some of the Sun-Serpent ceremonies indicated in the Mound Builder ceramics of several tribes. *A* represents two pieces of partially fractured pottery in the Hertzog collection. Their form is exceptional; both have similar deeply grooved parallel markings on the exterior, and remnants of legs, a feature rare in prehistoric American pottery. From the arrangement of the markings it would appear that the maker intended to represent some quadruped.

The clay and stone tobacco pipes of the Piedmont region suffer little in comparison with those which have been found west of the Blue Ridge and some of them are unique in their excellence. I do not remember to have seen, or to have read of, a Mound Builder pipe as good as that shown in figure 188, *A*, and it is well known that in the technique of the "platform" and "monitor" pipes the Mound Builders excelled. Their productions in this line are among the best examples of prehistoric American stone work. Some authors have questioned the antiquity of the bird pipes of the Mound Builders, but a careful study of the works of those who have done so and of the examples of these objects in the Greenville collections leaves no doubt in my mind that they are purely aboriginal and were not made by white men for the Indian trade. The unfinished "bird pipe" in figure 188, *C*, is very significant in this connection. It is a fine stone pipe in which the bowl has not been hollowed out or the stem perforated.

The occurrence of stone bird pipes in the eastern Mound Builder area proves that they were the occasion for long journeys or passed long distances in trade, and I am reminded of a stone bird pipe from Turks Island figured by Rudolf Cronau in his book on America, which is so close to one from South Carolina shown here as to indicate that it was probably brought to the West Indies from the continent.

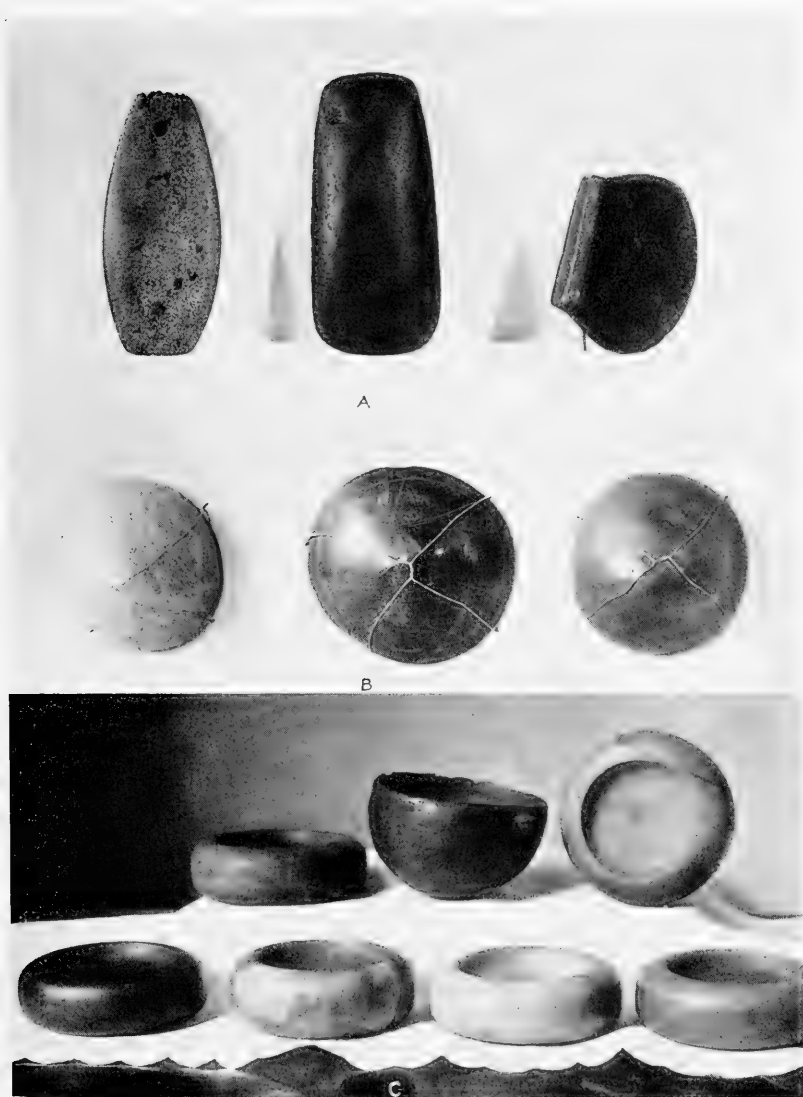


FIG. 189.—*A*, Two small pendants and side view of small bowl; *B*, three conical stone objects of unknown use; *C*, six stone objects, highly polished, resembling chunky stones (used in popular game played among tribes of Gulf area) but hollowed on only one side, and one small clay bowl. (Schwing Collection.)

Our knowledge of the Indians who inhabited the Piedmont area of South Carolina is imperfect, derived mainly from the writings of a few travelers and traders whose observations were made between two hundred and three hundred years ago, and they afford us little information regarding the culture of the people. The artifacts here figured are the same as those found in the Mississippi Valley belonging to the so called Mound Builder culture, the most highly developed in North America north of Mexico, and the recognition of their affinity is most important. If the people who made them may be classed with the Mound Builders, they were no longer mere hunters and fishers but had in fact reached the agricultural stage. They constituted a marginal area of that great mound building culture, which, in prehistoric times, was one of the highest and most widely extended in North America, and to a knowledge of this a more extensive examination



FIG. 189a.—Tugala Creek, Piedmont region of South Carolina.
Small globula vase luted to lip of a larger.

of these and similar objects will vastly contribute. No addition to our knowledge of the Mound Builders from documentary sources is, of course, to be looked for, and we must therefore rely upon archeological investigation to add new pages to our limited knowledge of them and through them to our knowledge of prehistoric man in America. There are numerous mounds of considerable size in the region we are discussing which demand investigation and many more artifacts may undoubtedly be obtained from them. It is highly improbable that these mounds were made by the Indians found in possession when the country was first visited by white men. They are rather to be attributed to stocks related to those of the Mississippi Valley which, from causes unknown, had drifted eastward in prehistoric times. Only the archeologist can solve the problem which these mysterious people present—the Mound Builders of the Piedmont, whose nearest relatives were the better known Mound Builders of the Mississippi Valley.

A LATE BASKET MAKER VILLAGE OF THE SOUTHWEST

By FRANK H. H. ROBERTS, JR.,

Archcologist, Bureau of American Ethnology

The remains of a village erected during the late Basket Maker period were excavated by the writer in the Chaco Canyon, New Mexico, during the summer of 1927, to obtain much-needed information on a little-known phase of prehistoric southwestern archeology. The site is located on top of the mesa which forms the southern wall of the canyon nine miles east of the great ruins of Pueblos Bonito and Chettro Kettle. Originally the village consisted of 18 houses, a large circular ceremonial room or kiva, and 48 storage bins (fig. 190).

Prehistoric sedentary cultures in the southwest have been grouped into two divisions called Basket Maker and Pueblo, the latter including the cliff-dwellers. The Basket Maker group, which is the older, has three subdivisions and the Pueblo has five. It was towards the end of the third phase of the Basket Maker era that the village in the Chaco Canyon was built and inhabited. Intervening between its abandonment and decay and the present day was the whole Pueblo cycle.

During the Basket Maker III period, frequently called the Post-Basket Maker, the crude one-room domiciles which the people erected to shield themselves from the vagaries of the weather were generally located on mesa tops and along the upper ledges of canyon walls, if a large natural cavern was not available. The houses were indeed primitive. They consisted of an oval or rectangular excavation roofed over with a pole, brush, and plaster superstructure. The earth walls of the excavation were covered with thick plaster made from adobe or were lined with large stone slabs (fig. 192). In the latter case, the plaster was applied to the faces of the slabs. Four posts set in the floor about two feet from the corners of the room supported the superstructure. These posts carried a rectangular framework against which were placed the upper ends of small poles, the lower ends of which were embedded in the earth around the periphery of the excavation. These small poles formed the sloping, upper walls of the house. The rectangular space at the top probably had a flat roof with an opening in the center to serve as a smoke hole, possibly on occasions as an entrance. The entire wooden structure was then covered with twigs, bark, and plaster (fig. 191).

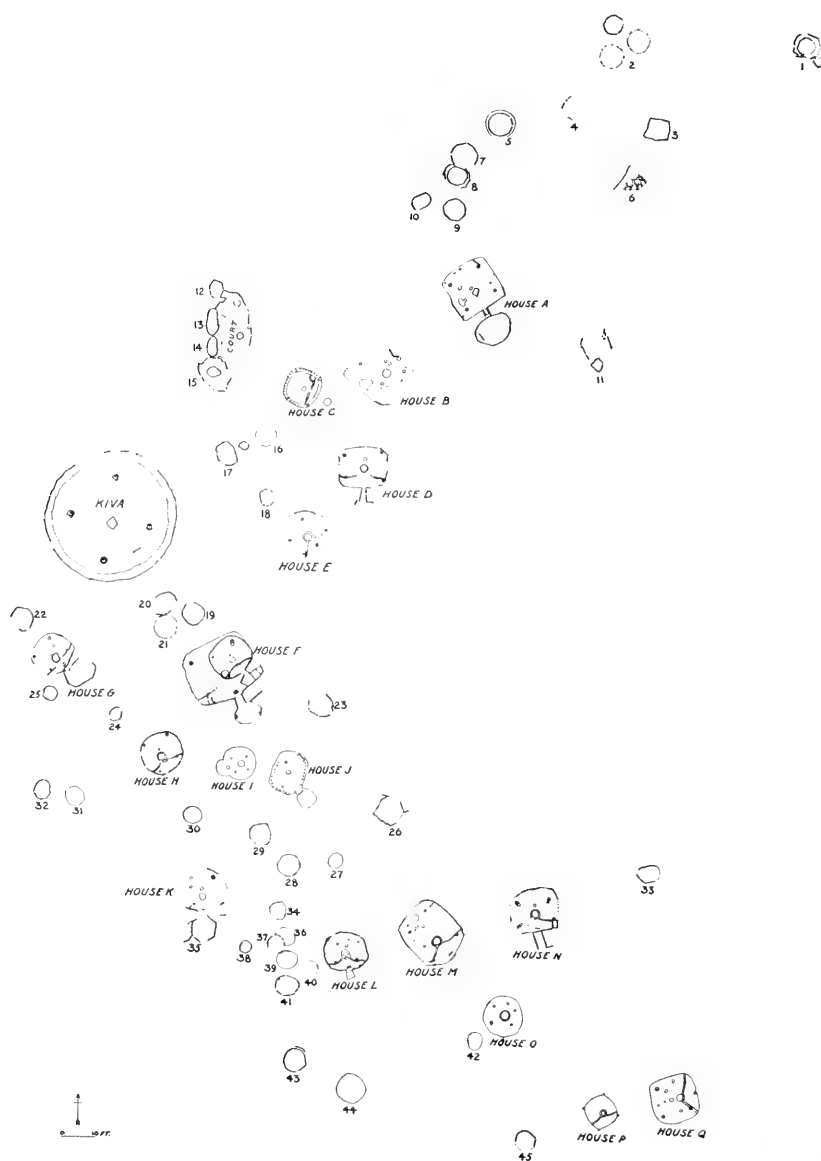


FIG. 190.—Plan of Late Basket Maker village in Chaco Canyon. Numerals denote storage bins.

Little remained of the interior furnishings. In the center of each room was a rectangular or circular firepit. A few inches from the firepit was a small circular hole in the floor which is possibly analogous to the sipapu of later day kivas. The latter symbolizes the mythical place of emergence through which the present Pueblo Indians believe their ancestors passed on their journey from the underworld to the surface of the earth. In the days when the Chaco village was inhabited, each dwelling may have had its own shrine, whereas in following periods it was deemed essential only to the ceremonial house. Other small holes in the plastered floor no doubt served as storage places for small objects. In many of the houses a row of upright slabs

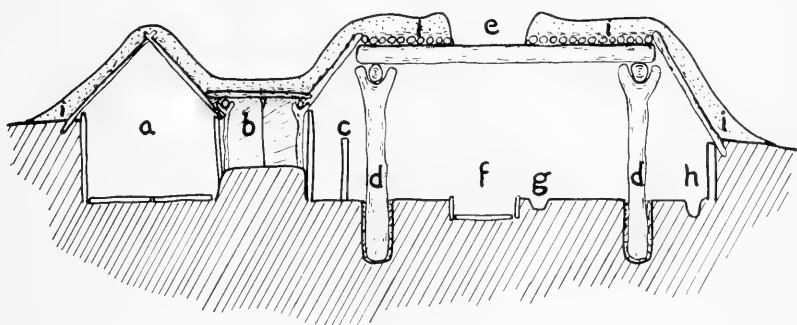


FIG. 191.—Probable method of house construction, *a*, ante-chamber; *b*, passage; *c*, deflector; *d*, support posts; *e*, smoke hole; *f*, firepit; *g*, sipapu; *h*, small storage pit; *i*, plastered covering on superstructure.

formed a bin-like compartment on the side in which the doorway was located (fig. 193). There was generally an opening in the center of this row of slabs immediately in front of the doorway. Associated with this was an upright slab set in the floor between the doorway and the firepit. The latter, like the deflector in kivas, would prevent cold air from rushing through the opening and directly onto the fire.

Most of the houses appeared to have had an entry-way on the south or southeast side. The doorway of the main room gave access into a short passage which in turn opened into an oval room. The latter was roofed in much the same fashion as the dwelling except that there were no interior supporting posts. Because of its smaller size the sloping side poles would carry the weight of the superstructure without additional aid. They probably met at the center, giving a conical shape to the covering. The ante-chamber of these domiciles

is suggestive of the entry-ways in earth lodges built by modern Indians, by the Eskimo, and even by the Palae-Asiatic peoples.

The dimensions of the main room of the houses averaged 12 by 14 feet, and the excavation was three feet deep. The angle of the small post holes around the periphery indicated that the ceiling of the flat portion of the superstructure had been about six feet above the floor.

A striking and somewhat unexpected feature of the village was the large circular enclosure which appears to have been a kiva. As in the houses, slabs were used extensively in its construction. Large flat



FIG. 192.—Typical house remains, illustrating use of stone slabs in lining the excavation. Post holes and firepit shown in floor of room. Ante-chamber beyond doorway in center of slab wall.

stones lined the periphery of the excavation and the facing of the encircling bench was of the same material (fig. 194). The space between the two rows of slabs was filled with adobe mortar and stone spalls. On top of the bench was a smooth hard coating of plaster. The roof was supported on four large posts and no doubt was of the same type of construction as in the houses. There was a rectangular firepit near the center of the room but no "sipapu" in evidence. Set in the floor between the firepit and the south side of the room was the broken end of a large stone slab, the deflector. There did not appear to have been an ante-chamber on the southern side and the entrance to the structure was probably through the roof.



FIG. 193.—Remains of compartment formed by placing a number of up-right stone slabs across one side of room. Doorway and deflector slab at left center of picture. Firepit in the right foreground.



FIG. 194.—View of Kiva showing use of slabs in face of bench and outer wall of structure. Burned timbers on floor are the remains of roofing.



FIG. 195.—Typical Late Basket Maker bowls. Diameters from left to right, $5\frac{1}{2}$ inches, 8 inches, 6 inches.



FIG. 196.—Various kinds of bone implements used by Late Basket Makers. Largest implement is 10 inches long.

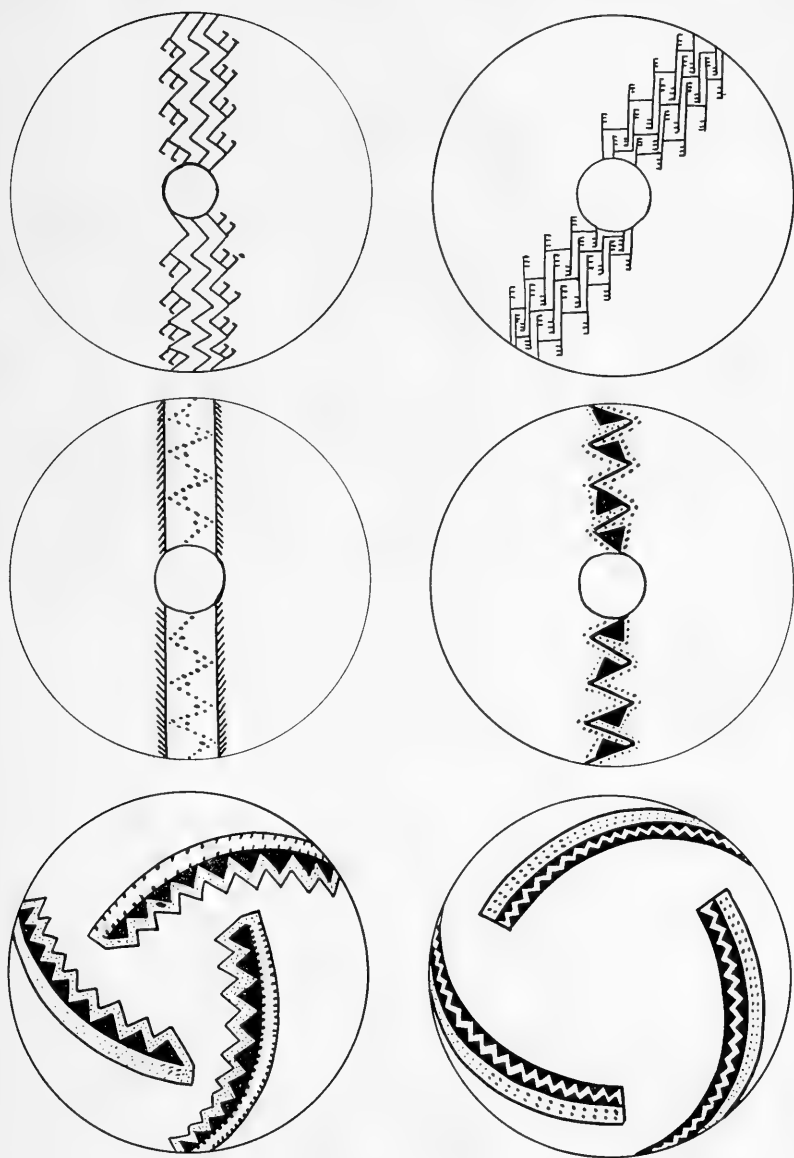


FIG. 197.—Characteristic decorations from bowl interiors. Pigment in all cases tended to a brownish black.

The diameter of the outer circle of slabs was 40 feet, and the inner, the face of the bench, averaged 36 feet. It is possible that in this structure is to be seen the predecessor of the great kivas of the Chaco pueblo cultures.

Bins in which was stored the corn, raised on the canyon floor below, were simple in form and were constructed in the same fashion as the dwellings. They differed, however, in that no interior support poles were used in the construction of the roof. The latter, like the ante-chamber coverings, was no doubt cone-shaped. The circular or oval pit averaged about six feet in diameter and three feet in depth.

Pottery found at this village was crude compared to that of the following pueblo periods (fig. 195). Characteristic forms were full-bodied jars with constricted, bottle-neck openings; full-bodied vessels with wide orifices; globular-shaped pots with a small opening at the top; pitchers; bowls; and ladles. There were no corrugated pieces of the type commonly found in pueblo ruins. The surface finish on the vessels is rather rough. The general color is a grayish to brownish white. Ornamentation of the wares was confined to painted decorations on bowl and ladle interiors. The designs were simple and in general are highly suggestive of the basketry of the preceding period (fig. 197). The pigment is a brownish black in color.

There was a great variety of bone implements, needles, awls, scrapers, and hair-pins in the material from the houses (fig. 196). Stone objects were chiefly in the form of metates, manos, mauls, scrapers, knives, and a few arrowheads. The bow and arrow was just coming into use at the end of this period.

The village had no definite cemetery. The dead were interred wherever it was found convenient to scoop out a shallow grave. In practically all cases the body had been placed on its back, head to the west, face to the north, with the knees flexed. Only three of the burials had accompanying mortuary offerings. The absence of grave furniture does not necessarily imply that the dead were buried without the usual offerings of food and water to sustain the spirit in its journey to the great beyond. At that stage in southwestern development, when pottery was just beginning to be used, baskets were the main containers, and it is probable that the funerary deposits were of materials which long since have crumbled into dust.

THE MISSION INDIANS OF CALIFORNIA

By J. P. HARRINGTON,

Ethnologist, Bureau of American Ethnology

The Presidio of Santa Barbara has been founded only 155 years, the Santa Barbara Mission, only 141 years. Yet this brief period has seen two distinct forms of European civilization sweep over the fertile lands of the valley of Santa Barbara, a Spanish and an American culture, each with its peculiar institutions, language, and details of life. Only sierra and sea still have the appearance which they presented in Indian times, and in the valley perhaps a few oak trees or hillside boulders which have escaped molestation; but not a trace is left above ground of the intricate native civilization, the Indian mode of life, which seemed up to the beginning of this foreign period so stable and natural and so conducive to health and longevity that the native people never dreamed that any other mode of living was possible.

For the purpose of obtaining further important information on the ancient languages and customs of this region, the writer was sent to the field at the close of October, 1927, and continued his field studies until the end of the year, obtaining a large mass of information linguistically correct and in part new, in part corroborative of information obtained in previous years regarding the ancient culture. Working with the poor last survivors, and these too young to know many things except by hearsay difficult of interpretation, the great task has been correctly to supply the details of the former culture, and this is impossible of accomplishment except through an exhaustive analysis of the language. Much was learned however, from reliable Indian informants, of the native customs and mode of life of the Mission Indians of former days.

It was the ideal of these Indians to go about in the lightest costume possible. Their children were in and out of the water all day long, and the men and many of the women were expert swimmers. Children and adults rarely if ever caught cold and attained an excellent muscular development. They were a race of runners, swimmers, hunters, and fishers. The only clothing prescribed was a petticoat for the women. Warm blankets sewed or woven of skins were at hand for those who cared to wear them.



FIG. 198.—Luisa.



FIG. 199.—Ramón Ganez, showing beard said to have been worn by some men in ancient times.

Men frequently wore the hair in a pug on the front of the head, standing up in Goddess of Liberty fashion, and the women wore bangs. A wig of Chinese hair was found very useful by the writer in studying hair dressing. All the effect of a kaiser moustache was given by a bar of shell inserted through the nose of the men. Face and body hairs were plucked out, using clam shells as tweezers.

The Indian family would rise at daylight and take a plunge in the nearest water. After a light breakfast they were off for the adventures of the day. The men would go hunting or fishing or visiting around on business that seemed as important to them as ours does to us, the women in quest of seeds, roots, greens, basketry materials. There was much lunching or munching all day long. The meal of the day was when the people had returned to camp in the evening. The staple food was acorn mush, along with a great variety of other natural products, many of them delicious, prepared by peculiar processes. Sometimes a midnight lunch was eaten, especially in the long winter nights.

The principle of the Turkish bath was known to these Indians. In a lodge that could be shut up tightly, either dug into a cliff or built semi-subterranean fashion with entrance at the top, a hot fire was kindled with light wood. After the bathers had become very warm in these lodges, they suddenly emerged and ran, often with shouts, to near-by water and plunged in, and after splashing about for a time, reentered the bath lodge to become dry and warm again.

The Indians were a proud people, alert and shrewd, and carried an age of eighty or ninety years much more lightly than white people do. There are authentic records of extreme age among these Indians. Even when lounging about camp, they were taught to be alert, and to maintain such positions that they could spring to their feet in an instant.

The houses were shaped like a half orange, and were constructed of a framework of willow or sycamore poles, thatched with tule, carizo, brakes, or other material at hand. There was a low door, and some huts had holes for windows. With a sharp stick one could poke through the wall of the hut, and mischievous boys sometimes tried this trick on the unsuspecting inmates. A rancheria or village consisted of a group of a few of these houses, usually arranged in chance rows. Each rancheria had a captain, distinguished in no way, as far as dress or appearance went, from an ordinary Indian. He arranged fiestas with other chiefs, gave advice in many matters, but the whole social organization was most simple and democratic. There were no slaves.



FIG. 200.—The burial cache found at the E. W. Alexander ranch.



FIG. 201.—Showing locality of the burial cache, southeast of the Alexander ranchhouse at what was formerly Los Prietos rancheria.



FIG. 202.—Pounding acorn kernels for the preparation of the mush which was the daily food.

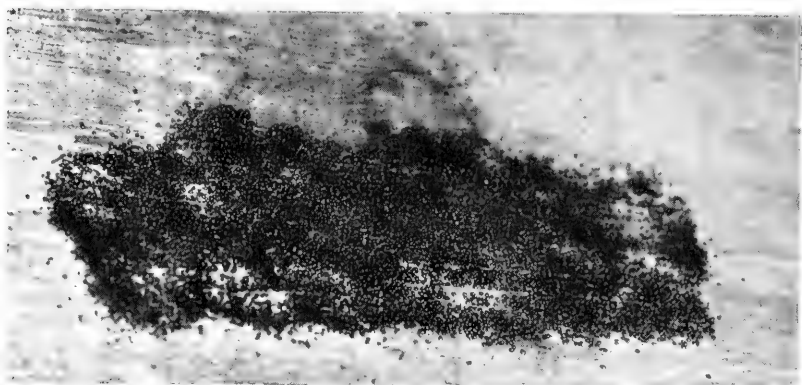


FIG. 203.—Seeds of *Calandrinia caulescens*, var. *Menziesii* Gray, sprinkled as holy water into the cache at the Alexander ranch and preserved through all the intervening years. Identification by Miss Helen H. Henry, Bureau of Plant Industry, through the kindness of Dr. W. R. Maxon.

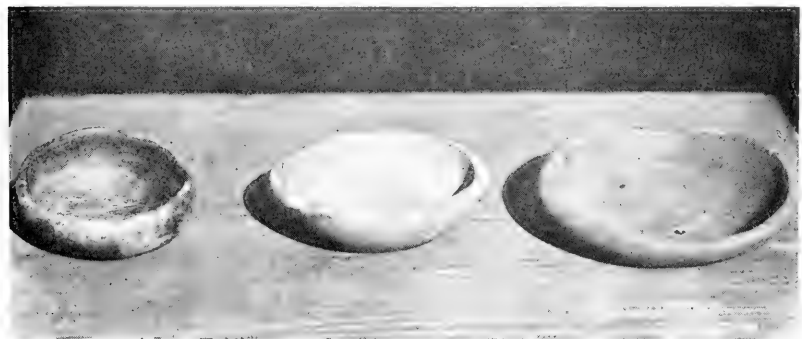


FIG. 204.—Saucer-like bowls of black and green steatite, E. W. Alexander ranch.

Special attention was given by the writer to the study of the manufactures of these people, so few of which are known except from excavated remains. Roughly speaking, stone, bone, and shell have survived in the ground, and all else has perished, except by the rarest coincidence. The nicety of the objects manufactured by these people called forth admiration in the diaries of early explorers. Considerable variation existed in the materials and methods of use of utensils and regalia.

The placenames contained in the Diario of Fr. José Maria Zalvidea, 1806, were deciphered from the original manuscript in the Santa Barbara Mission archives with the collaboration of my friend, Fr. Zephyrin Engelhardt, the historian of the Missions, the corrected list standing as follows: Jonatàs, Saca, Olomosoug, Geep, Jaliuilimit, Lisahua, Cuia, Siguicon, Sgene, Malapoa, Napolea, Sisupistù, Tupai, Tacui, Yaguelamè, Majagua, Taslupí, Castegue, Atongai, Guapiabit, Guapia, Moscopiabit, Guapiana. The correct reading of several of these names is important, for they have hitherto been quoted in incorrect form.

At the special request of the Chief of the Bureau of American Ethnology, a study was made of the finds recently made at the E. W. Alexander Ranch near Santa Barbara. A large number of objects were unearthed by chance in the orchard of Mr. Alexander at the site of the former Los Prietos rancheria. It was a burial cache only a few feet in diameter, very likely made when the rancheria was abandoned. Through the courtesy of Mr. Alexander, black and green steatite dishes of saucerlike size and thinness were examined; also a round-ended and a straight-ended arrow-straightener, both beautifully made of black steatite. A pipe of black steatite contained *Calandrinia* seeds which had evidently been thrown into the grave as a votive offering, as was the custom. A symmetrical black flint spearhead measures five inches in length. There is a perfectly preserved abalone gorget, and a quartz crystal such as was used as a pendant on the breast or to surmount a ceremonial staff of wood or bone. The display of pecked sandstone mortars is only rivalled by the great steatite boiling pots, which were used for boiling acorn mush and other foods. Food never burned in the latter, and one of them would be handed down in a family for generations. Six of these great pots were inspected, all as new looking as if taken fresh from the fire, sooted on the bottom and glistening gray in appearance.

One of the interesting sites in this region is known as the *piedra medidora*. If a person who cannot squeeze through this cleft in a rock suddenly finds that he can pass through, it is a bad omen and portends a sudden death.

LANGUAGE STUDIES AMONG THE FOX AND NORTHERN ARAPAHO INDIANS

BY TRUMAN MICHELSON,
Ethnologist, Bureau of American Ethnology

In continuance of many seasons of field researches on the language and ethnology of the Fox Indians, I left Washington towards the close of May, 1927, for Tama, Iowa, where a Fox settlement is located. The Foxes at Tama have preserved their language in pure form, affording unusual opportunity not only for a study of the language itself, but for a clearer understanding of their myths and ceremonies.

A few days were spent at Chicago en route in measuring the Siksika skulls in the Field Museum, and in studying the distribution of designs on Indian medicine bags. From the measurements, it developed that the Siksika crania have fully as low a vault as the Sioux proper—in sharp contrast with other Algonquian tribes. In the study of the fiber bags it appeared that the combination of the Thunder bird and Panther on woven bags has a wider distribution than heretofore thought, but the belief that the Thunder bird always is associated with the Panther—although not necessarily the reverse—apparently holds true.

At Tama, it was evident that the Foxes had changed but little in the past year. When I first began my studies in 1911, only a small fraction of the tribe lived in shacks or frame houses, the rest dwelling in bark-houses in the summer and wigwams of rush in the winter; but now, although bark-houses with planks substituted for bark on the sides and roofing may still be seen, wigwams are rapidly disappearing. Most of the season's work was devoted to restoring phonetically accounts of various Fox ceremonies written by Foxes in the current syllabic script, and in acquiring new ethnological data in this script. It may be explained that this script is in syllables and evidently is based upon our ordinary script. When and how this system of writing arose is not known, but all Foxes use it with great fluency, and frequently write to the Sauks of Oklahoma in it, for although the languages of the Foxes and Sauks are not the same, they are so similar as to be mutually intelligible.

The texts restored phonetically related to the gens festivals connected with the sacred packs, a number of which are owned by each



FIG. 205.—Scar-face, a deceased Northern Arapaho. (Photograph by Michelson, 1910.) Scar-face was "a good sized boy when the stars fell." The time referred to is November, 1833. The meteoric showers made a deep impression on Indians of the Great Plains; and is used in checking events given by native informants.



FIG. 206.—Raising the center-pole at the Northern Arapaho Sun Dance, 1926. (Photograph by Michelson.) To successfully erect this pole is no mean feat of engineering; the mechanical skill shown compels admiration.



FIG. 207.—Northern Arapaho Sun Dance, 1926. (Photograph by Michelson.) The Southern Arapaho Sun Dance has been thoroughly described by Dr. George A. Dorsey. The Northern Arapaho are much more conservative than the Southern Arapaho; and the tribal sacred pipe is with the former. For years after the government forbade tortures in the Sun Dance members of the Northern Arapaho went to the forest, put skewers through their flesh, attached leather-thongs, and fastened these to trees while they wailed and danced—all in secret.



FIG. 208.—Fox building made of elm-bark, Tama, Iowa. (Photograph by Michelson.) Buildings of this kind are rapidly disappearing and will soon be a thing of the past. This building is one of the finest ever seen by Dr. Michelson.

gens. By use of these packs one could cause the foe to stand hypnotized in battle and thus be easily slain. In summer, feasting and dancing are connected with religious worship, but in winter there is no dancing. Features of the summer festivals are the four dances, the ceremonial eating of dog meat, and a prayer to the Spirit of Fire and He Who Lies With His Face In The Smoke-Hole (*i. e.*, the sky) that they correctly inform the particular manitou who, when bestowing a blessing, commanded the festival to be observed, that worship is being held. Descriptions of these festivals may be found in the 40th Annual Report and Bulletin 85 of the Bureau of American Ethnology.

On July 22, I left for Fort Washakie, Wyoming, to renew my researches among the Northern Arapaho. Through the courtesy of both the Superintendent and Principal, I lodged at the Shoshone Boarding School. The work here consisted chiefly of a study of the Arapaho language. Although it is known that Arapaho is Algonquian in stock, it is very aberrant. I worked out a number of very intricate sound shifts, whereby a larger proportion of the Arapaho words was shown to be Algonquian than hitherto suspected, and a few additional grammatical features were discovered to be Algonquian. Nevertheless a large part of the vocabulary apparently is not Algonquian in origin, and the source of this is still unknown. Incidentally I witnessed the Shoshone Sun Dance (the Northern Arapaho held none last summer; fortunately I saw the Sun Dances of both the Northern Arapaho and Shoshone in the previous season), and measured quite a number of Arapahoes and Shoshones. The study of these anthropometric measurements has not yet been completed, but the cephalic index of my series of Shoshones is quite comparable to that obtained under the direction of Dr. Boas more than twenty years ago. The work unfortunately was interrupted by the appearance of two motion picture companies. Of course I could not compete with the wages they offered the Indians, and moreover, all the Indians wished to see the pictures "shot" even though only a few hundred took actual part in them. I therefore judged it best to postpone my studies to a more favorable time, and so began my journey eastward, arriving in Washington September 1.

MUSIC OF THE WINNEBAGO INDIANS

By FRANCES DENSMORE

In the furtherance of her researches on the music of the American Indians, the writer went to Wisconsin in October, 1927, to study the music of the Winnebago. A study of Menominee songs had demonstrated their resemblance to the songs of the related Chippewa tribe, and one purpose of the present undertaking was to ascertain whether the songs of the Winnebago resembled those of the related Sioux or the neighboring Chippewa tribes.

The first locality visited was Black River Falls. An autumn ceremony had recently been held about 10 miles from that town, and the first call was made upon the man who had charge of the ceremony. He is a conservative old man, known as Frank Mike, and is the owner of the morning star bundle. His home was a considerable distance from a traveled road, and near his house stood the framework of the long lodge where the ceremony had been held, this being similar to the medicine lodge of the Chippewa and Menominee. Adjoining this was the frame of a sweat lodge, and back of it was a structure of heavy poles from which were suspended hooks for hanging kettles over the fire, this being the cooking-place used during the ceremony. It is interesting to note that the hooks were made of two crotched sticks firmly fastened together with wire, one crotch being over the horizontal pole while the other crotch, hanging downward, formed the hook for the kettle. Beyond the cooking-place were the frames of several lodges intended for the use of visitors. Near the ceremonial lodge stood a small tree around which the grass was trodden in a circle about eight feet in diameter. This circle had been made by the feet of men and women who recently danced the scalp dance, the tree representing the pole on which scalps were formerly hung. The dance had continued all night.

In two long conferences with Frank Mike, the work of preserving Indian songs was explained. He was reluctant to sing without consulting the other bundle-owners, but his songs can probably be obtained at a subsequent time. Calls were made, with an interpreter, on Indians living over a radius of about 20 miles, but no recording was done in this locality. Two Indians had, however, been favorably



FIG. 209.—Peak near camp of Thunder families, known as Sheep's Hill among the Indians because of a tradition that mountain sheep were formerly seen on its summit.



FIG. 210.—Home of David Little Soldier in which Winnebago songs were recorded. (Photograph by Miss Densmore.)



FIG. 211.—David Little Soldier, Winnebago singer.
(Photograph by Miss Densmore.)



FIG. 212.—John Thunder, Winnebago singer and interpreter.
(Photograph by Miss Densmore.)

impressed and said that if the work were transferred to a place near their home, they would be willing to sing. These Indians are sons of a prominent Winnebago of former times, named Thunder, and they live in what may be called a permanent camp, about five miles south of Galesville, Wisconsin. The writer then proceeded to Galesville and went to their camp each day, obtaining many songs there and from a Winnebago living at Trempeleau, a village about 10 miles southwest of Galesville, on the Mississippi River. The dwellings of the Thunder family are near the battlefield on which the Winnebago fought a notable battle with the Sioux. The house in which the songs were recorded is shown in figure 210, and figure 209 shows an elevation near the camp which is known as "Sheep's Hill."

The songs that belong to distinctively Winnebago feasts and ceremonies were the object of special research. The War-bundle feast, held in midwinter, is such a ceremony and 25 of its songs were recorded, including songs of the thunderbird bundle and the bear, morning star, and spirits of the night bundles. Other distinctively Winnebago groups are the songs of the Buffalo dance, held in the spring, and the songs of the Heruka. Numerous songs of both classes were obtained, the Heruka songs being recorded by David Little Soldier (fig. 211), a son-in-law of Thunder. The Heruka were said to be "bow and arrow spirits," resembling Indians in appearance but small in stature and living in high mountains. Their songs were concerning the power of their bows and arrows, and it was said that they taught the use of these weapons to the Indians.

The customs pertaining to the use of music in the treatment of the sick were found to be similar to those in other tribes, a doctor receiving songs in his dreams and believing that his power was increased if someone joined him in singing the songs. Thunder dreamed of the Day and of a white buffalo, and the songs used by him in treating the sick were recorded by two of his sons, one of whom, John Thunder (fig. 212), acted as interpreter for the entire work. Another important group of healing songs belonged to the grandfather of John Henry, living at Trempeleau, Wisconsin, who recorded them, and also transferred to the writer a bone whistle blown by his grandfather when singing for the sick. The whistle is made of a wingbone of a wild swan and is etched with figures of a turtle, a deer, a medicine lodge and other symbols of his dreams and his power. Two tones, slightly different in pitch, were obtained by a peculiar manner of blowing the whistle, these tones being recorded together with the songs.



FIG. 213.—Tom Thunder, Winnebago singer. (Photograph by Miss Densmore.)

Tom Thunder (fig. 213) recorded a song that was "dreamed by his grandfather," this song containing the words, "Everyone should wake before the sun rises." An interesting group of songs was said to have come, in a dream, from four spirits that live in the water at the Dalles of the Wisconsin River. Many recorded songs were connected with the warriors of former times, including Green Cloud's song with the words "In all the tribes I do not find such a man as I am"; Part Wolf's songs of victory over the Sioux, and the song of Standing White Cloud, who wept because he arrived after a battle was finished. A group of interesting modern songs was composed in France by members of the tribe who were serving in the World War. Songs of the moccasin game were recorded, and data on the general customs of the tribe were obtained. The storing of food for the winter was in progress and the drying of squash was seen and photographed, the squash being cut in circles and strung on wires. Baskets were also being made from the wood of the black ash trees, by a process said to have been received by a woman in a dream.

A group of effigy mounds in the vicinity of Thunder's camp was visited and photographed. It was said these mounds were made by Winnebago, each mound in the shape of a man's "dream-animal," and that these mounds were refuges in time of war. This information was given by members of the Thunder family and was corroborated by the Winnebago living at Trempeleau. All agreed that there was a "dugout" under each mound, some being of considerable size, and that provisions were placed in them so that a man could remain in hiding for some time. The opening was disguised, and this was "a way by which a man's dream-animal protected him." The effigy mounds were eight in number, representing various animals, the largest being 108 feet long and about $2\frac{1}{2}$ feet high.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1928



(PUBLICATION 3011)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION

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PREFACE

Field exploration provides an indispensable tool in the scientist's efforts to increase knowledge. Many parts of the face of the earth are yet but imperfectly known to science, and even in those parts supposedly well-known, intensive field investigations continue to bring to light new facts and new specimens of importance to a full knowledge of the earth and its life. In the attempt to aid in expanding the boundaries of that knowledge, particularly in the fields of geology, biology, and anthropology, there go out each year from the Smithsonian Institution numerous expeditions, not only to many parts of our own country, but to the far corners of the earth—China, Africa, Labrador, and the islands of the sea. Observations are made in the field, and hundreds of thousands of specimens are brought back to Washington for later study at the Institution.

The scientific results of these expeditions are published eventually in the various technical series issued by the Institution; the present pamphlet serves as a preliminary announcement, by word and picture, of the aims and scope of Smithsonian efforts in field exploration during 1928.

W. P. TRUE,
Editor, Smithsonian Institution.



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FIG. 1.—The 100-inch telescope, Mount Wilson Observatory, where the fly-wing radiometer was used.

STUDYING THE SUN AND STARS

By C. G. ABBOT,

*Secretary of the Smithsonian Institution, and Director of the
Smithsonian Astrophysical Observatory*

It will be recalled that the Smithsonian Institution has two observatories, one in Chile and the other in Southern California, making daily measurements of the intensity of the sun's rays, on which all life depends. The Institution also administers the similar solar observing station of the National Geographic Society in South West Africa. These three observatories, situated on mountain tops in desert localities, have cooperated for several years in observing the solar rays on nearly every day.

As anticipated a year ago from a study of regular periodicities recently discovered in the variation of the intensity of the sun's rays, the solar radiation rose to a feeble maximum in the spring months, and declined to a marked minimum in the autumn of 1928. Should these observed periodicities continue to prevail in solar radiation, it may become possible soon to forecast the general march of the sun's energy for a year or more in advance, and also to forecast such climatic or other terrestrial concerns as may be shown conclusively to depend thereon. Short-interval irregular solar variations also seem to occur, but in a manner not predictable. The daily results of solar radiation measurements, through the kindly cooperation of the Chief of the U. S. Weather Bureau, are published on the Washington weather map.

The writer and Mr. H. B. Freeman of the Astrophysical Observatory occupied the Smithsonian station on Mount Wilson, California, from July to mid-September, 1928. They improved the somewhat celebrated solar cooker, installed there some years ago, by employing vacuum jackets for the heater tube, and by better protecting the apparatus in other ways from loss of heat. Series of measurements were taken of temperatures in the ovens and elsewhere in the apparatus at all hours of the day. The ovens remained for several weeks at temperatures between 140° Centigrade at sunrise and 175° Centigrade at mid-afternoon, so that baking and other operations of cooking could be done at all hours of night as well as day, even though the exposure to sun-rays was limited to about seven and one-half hours per day by the shading of trees.

Many years ago, under Secretary Langley's direction, the Astrophysical Observatory made a study of the solar spectrum beyond the

visible end of the red, in order to discover and map the lines of absorption there, produced by gases and vapors in the atmospheres of the sun and of the earth. These infra-red rays are largely inaccessible to photographic or visual observation, and were observed by the heat they produce in that fine, blackened, electrically-connected strip of metal called the bolometer which Langley invented. As published in Volume I of the *Annals of the Astrophysical Observatory*, about 550 lines were found by the bolometer between the line called A by Fraunhofer, which lies in the deepest red, and the great infra-red band called Ω by Langley.

The writer and Mr. Freeman set up more powerful apparatus and examined this region anew. They found about 2,000 lines where about 550 had been detected before. Their results are much appreciated, and are being employed in various researches, notably by Dr. Babcock of the Mount Wilson Observatory in his identifications of the chemical elements represented in the sun by their infra-red spectra.

The writer continued his research, in cooperation with the Mount Wilson Observatory, on the distribution of energy in the spectra of the stars. Just as the color of the blacksmith's iron gives a notion of its temperature, so, under carefully measured conditions, does the study of the heat of different colors of their spectra give means of estimating the temperatures of the stars. Furthermore, when both the temperature and the distance of a star are measured, we may estimate how large a star at that temperature and that distance must necessarily be in order to send to the earth its observed total intensity of radiation.

Four years ago, the writer succeeded for the first time in observing the spectra of 10 of the brightest stars in this way. He used the radiometer, an instrument similar in principle to those sometimes seen in rotation in sunlight in opticians' windows. In August and September, 1928, he succeeded with a new form of the radiometer in observing the energy of the spectrum of the planets Mars and Jupiter, and of 18 stars, of which most were fainter than the second magnitude, and one was of magnitude 3.8.

The results were very accordant on successive nights, and will add decidedly to our knowledge in this field. In the instrument used, the vanes were made of house-flies' wings, about 1/75 inch wide and about 1/25 inch tall. The instrument was suspended in hydrogen at about 1/5000 ordinary atmospheric pressure by a quartz fiber too small to be readily seen by the eye, even in selected lighting. Some idea of the

fineness of its suspending fiber may be gathered from the fact that a fragment of a Dennison gummed label, $\frac{1}{8}$ inch wide and $\frac{3}{8}$ inch long, was too heavy to be carried without breakage by the quartz fiber. Also it was found that when suspended in a wide bottle in air at ordinary atmospheric pressure the top of the suspending fiber could be turned through more than 40 complete turns before the little radiometer hung at its lower end responded by any perceptible rota-

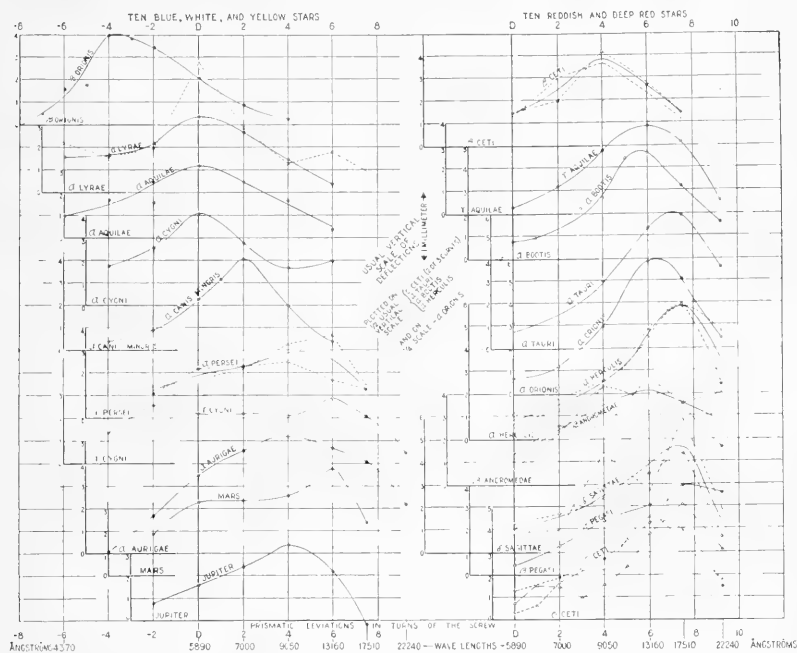


FIG. 2.—Distribution of heat in the prismatic spectra of 18 stars and 2 planets.

tion. The air, in fact, acted as if viscous, like molasses, to this minute force.

In order to observe the indications of the radiometer, it was provided with a mirror made by thinly plating with platinum a bit of glass smaller than the head of a pin, and made by grinding and polishing to one-third ordinary thickness the cover glass used for mounting specimens for microscopic examination. This thin mirror reflected a little auxiliary beam of electric light to a distance of almost 20 feet. At the hottest parts of their spectra most of the stars examined, though their rays were collected by the great 100-inch telescope, were only powerful enough in shining on the fly-wing vane of the instrument

to deflect the recording spot of light (whose lever arm, as just explained, was nearly 20 feet) by less than $\frac{1}{16}$ inch. Nevertheless, so beautifully quiet and free from accidental disturbances was the recording spot that in successive determinations of spectrum energy on different nights the agreement was usually excellent, and the divergences hardly exceeded the thickness of a sheet of paper on the scale of 20 feet lever arm.

In all this work the aid and encouragement of Dr. Adams of the Mount Wilson Observatory was invaluable.

A VISIT TO THE MINERAL-PRODUCING REGIONS OF NEW ENGLAND

By GEORGE P. MERRILL,

Head Curator, Department of Geology, U. S. National Museum

To inspect certain of the well-known mineral regions of New England with a view to future explorations, rather than to acquiring new materials, I made a somewhat hurried trip through parts of Maine, New Hampshire, and Vermont.

Leaving the Isle of Springs, where I had been passing a few weeks' vacation, I proceeded by train and auto to Andover, Maine, where under the guidance of Mr. W. D. Nevel I was able to study the pegmatite deposit in the adjoining town of Newry. This proved to be a typical case of feldspathic replacement as made known through the researches of Doctor Schaller, and was of particular interest not only because of its green and pink tourmalines, lepidolite, and large amblygonites, but also because it is the only deposit worked for the rare mineral pollucite, a silicate of caesium and aluminum, which was at one time considered to be of promise as a source of caesium salts for use in the manufacture of radio apparatus. From Andover I proceeded to the well-known and historically interesting gem locality at Paris Hill in the same State. Mining operations were quiet, so that opportunity was offered only of examining a large series from former workings, including one of the finest green beryls known, which had already been sold to Harvard University. From Paris Hill I proceeded to an inspection of certain localities in New Hampshire, making my headquarters at Canaan with side trips to the desired points. Old workings in Grafton and Acworth were visited which were noted in the past as producers of gigantic beryls. Both localities proved of exceptional interest, but it was not deemed advisable to attempt under existing conditions the extraction of any of the crystals, owing to their inaccessibility and the consequent cost. From Canaan, I went to Bellows Falls, Vermont, and through the courtesy of the officials of the Board of Trade was enabled to visit several of their feldspar prospects. The mines, though producing feldspar and quartz in commercial quantities, were singularly barren of other desirable minerals.

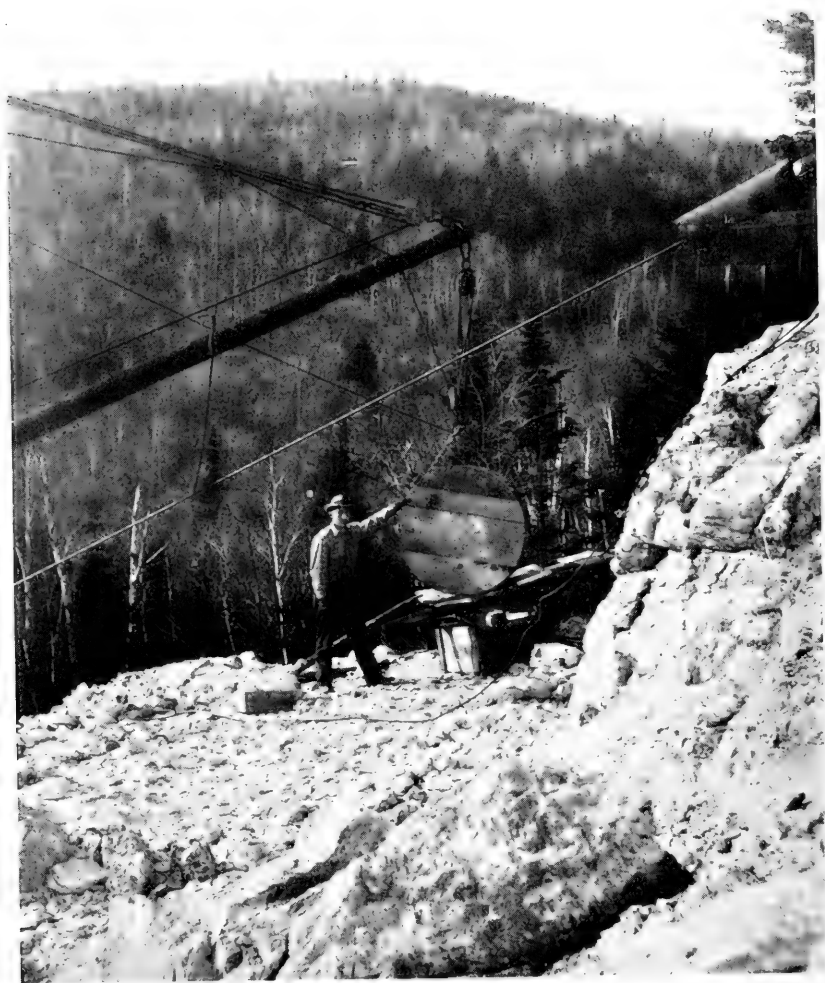


FIG. 3.—Quarry at Newry, Maine, where a big tourmaline mass was obtained.

HUNTING DINOSAURS IN MONTANA

By CHARLES W. GILMORE,

Curator, Division of Vertebrate Paleontology, U. S. National Museum

In the northeastern part of the Blackfeet Indian Reservation in northern Montana are areas of broken country known as "badlands" in which occur the fossil remains of dinosaurs and other extinct reptiles. It was in these deposits along Milk River that in 1913 I discovered the type specimens on which the horned dinosaur *Brachyceratops montanensis* was established. This interesting animal, together with other specimens of scientific importance collected during a few weeks work in that year, marked the region as so promising that further investigation has long been desired.

In 1928 the project finally became a reality, and in May I left Washington for Cut Bank, Montana, the base of operations, where I was joined by Messrs. Geo. F. Sternberg and Edwin Cooke, both of Hays, Kansas, the former serving as field assistant, and the latter as cook for the party. The day following the organization of the expedition, we proceeded to the Milk River locality where camp was established on the south bank of the stream, and the systematic search of the exposures began. Collecting was carried on here from May 16 to June 2 with only fair results. The more important specimens found were a partial skeleton of a large carnivorous dinosaur, some 60 bones of a duck-billed dinosaur (*Hypacrosaurus*) including parts of the skull, a portion of the frill of *Styracosaurus*, the first reported occurrence of this animal outside of the Red Deer River region, Alberta, and the skull of an armored dinosaur, which because of its rarity is always of interest.

Having prospected all of the exposures on this side of the river by June 2, camp was moved to the north bank and work was resumed there with better returns. The most noteworthy specimen found was a complete skull and more than 100 bones of a disarticulated skeleton of *Panoplosaurus*, one of the least known of the armored dinosauria. A partial skeleton including parts of the skull of *Monoclonius*, a horned dinosaur of this period, was also collected. One of the most interesting discoveries was a stratum literally filled with the scattered bones of a small Hadrosaurian or "duck-billed" dinosaur (see fig. 4). Many individuals were represented, and as nearly all appeared to pertain to a single kind, a collection of practically all parts of the

skeleton was made. The considerable number of individuals present here is attested by the fact that nine dentaries (lower jaws) were found in this one spot. The fossils were in an excellent state of preservation and form a good study series. The quarry was not yet exhausted when it was decided to discontinue further work here.

All of the area on the north side of the river having been inspected by July 1, our activities were transferred 50 miles to the south to exposures along the Two Medicine River. This area of badlands from the viewpoint of a fossil collector was the most promising-looking ground that we had encountered. The country was deeply dissected,



FIG. 4.—Collecting dinosaur bones on the Blackfeet Indian Reservation, Montana. (Photograph by G. F. Sternberg.)

the surfaces were free from vegetation, and there were many low-lying, rounded exposures—precisely the conditions that give promise of easy and profitable collecting. Much to our disappointment, however, in the 10 days spent here, only one specimen worth collecting was found—a partial skeleton, including parts of the skull, of a duck-billed dinosaur.

The Two Medicine formation was particularly disappointing in the lack of articulated specimens, for inasmuch as this formation is regarded by geologists as in part equivalent in age to the Belly River formation of the Red Deer River region some 150 to 200 miles to the north, from which numerous articulated skeletons have been obtained, I was led to hope that equally well-preserved specimens might



FIG. 5.—Fossil bones of a duck-billed dinosaur, shown as they lay in the ground. (Photograph by G. F. Sternberg.)



FIG. 6.—Collecting the disassociated skeleton of the armored dinosaur *Panoplosaurus*, on Milk River, Blackfeet Indian Reservation, Montana. (Photograph by G. F. Sternberg.)

be found in the Montana field. Although isolated individuals were frequently found, all had the bones of the skeleton disarranged and scattered.

All accessible collecting territory having been covered by July 15, the fossils were packed in 13 boxes weighing together 5250 pounds and shipped to the Museum. Although disappointing in that it did not contain one articulated skeleton suitable for exhibition, the collection made is most important scientifically. One if not two of the specimens are new to science, and others will contribute materially to a better understanding of the skeletal anatomy of the genera to



FIG. 7.—Fossil-bearing exposures along the Two Medicine River, Blackfeet Indian Reservation, Montana. (Photograph by G. F. Sternberg.)

which they pertain. The collection as a whole will make a decided contribution to our knowledge of the meagerly known fauna of the Two Medicine formation, and will enable it to be comprehensively compared with the faunas of other Upper Cretaceous faunas both to the north and south. Practically all of the specimens obtained are new to the National collections and fill gaps of long standing.

Upon the completion of the work in northern Montana, I proceeded to Bear Creek, a coal-mining camp in the southern part of the State, to investigate the practicability of securing a collection of Paleocene mammals, whose remains occur here in the Eagle coal mine. The attention of the Museum officials had been directed to this locality

through the kind offices of Dr. J. C. F. Siegfriedt, a resident of Bear Creek, who was also generous of his time and knowledge in assisting in my investigations. Examination of the Eagle mine showed the occurrence of the fossil remains to be in a thin stratum that immediately overlies the coal in the roof of certain parts of the mine. In this layer has been found a considerable variety of minute mammalian fossils in addition to the scattered bones of Rhynchocephalian reptiles, crocodiles, turtles, and fish. Limited time did not permit me to make a collection of these fossils on the spot, but 400 or more pounds of the "pay dirt" was boxed and shipped to Washington where it can be carefully gone over for its minute fossil content. Arrangements were also perfected with the mine foreman whereby additional fossil-bearing rock may be obtained should more be desired. Paleocene mammal remains are among the rarest of fossil specimens, so that the discovery of this new locality in what is probably a different geological horizon from those previously found in Montana is of much scientific interest.

On the return journey from the field I took the opportunity of examining the paleontological collections of the University of Utah, Salt Lake City; the University of Wyoming, Laramie; the Colorado Museum of Natural History, Denver; the University of Kansas, Lawrence; and the Field Museum of Natural History, Chicago.

FURTHER STUDY OF THE PROBLEM OF EARLY MAN IN FLORIDA

BY J. W. GIDLEY,

Assistant Curator, Division of Vertebrate Paleontology, U. S. National Museum

During the last few years the Smithsonian Institution has been interested in scientific investigation of the Pleistocene fossil-bone-bearing deposits in eastern Florida, especially in connection with the problem of early man, and expeditions have been conducted there as time and funds for field-work became available. In continuation of this work I went to Melbourne in the latter part of January, 1928, and spent two months at that place, at Vero, and at other east coast locations, making collections of material and a systematic and critical study of the deposits.

As a result many new data were obtained which have an important bearing on the highly interesting and much discussed question of the presence of early man in Florida. This question was first raised in 1916, when Dr. E. H. Sellards, then State Geologist of Florida, reported the finding at Vero of fossil human remains and artifacts associated with the fossil bones of an extinct vertebrate fauna. Subsequent investigations at Vero, but more especially those at Melbourne, have added considerable evidence which seems to confirm Dr. Sellard's view of the contemporaneity of man and the animals whose remains have been found intermingled. But owing to the nature and shallowness of the deposits, which might permit, through burials or otherwise, a comparatively recent mingling of human remains with bones of an older geologic age, there have been wide differences of opinion as to the interpretation of the association of material found in them.

The country is low-lying and flat where these fossil-bone-bearing beds are located, and before drainage canals were dug by modern man the best fossil-yielding areas were for the most part covered by swamps and heavy swamp vegetation. Even with the land now drained of most of the underground water, prevailing conditions make difficult the task of working out and properly interpreting the geologic structure and relationships of the two principal deposits involved. It was thus early recognized that worth while results and a satisfactory solution of the main question could be obtained only by extensive excavations and systematic study of the deposits over considerable areas. The earlier expeditions were much limited by the lack of



FIG. 8.—Crane Creek, Melbourne, Florida. Typical swamp such as formerly covered the areas at Melbourne and Vero where research investigations were carried on.

sufficient funds with which to carry on the work and develop the most effective methods of exploration.

The new methods adopted in my work of the past season at Melbourne I found most effective both in collecting and keeping separate the fossil bones of the different formations and in the critical study of the geologic structure of the two principal beds involved, as well as in studying the character of the contact plane between them.

The sedimentary deposits under investigation at the Melbourne locality are relatively shallow, averaging not more than 8 or 10 feet in thickness. They lie everywhere on an uneven floor of consolidated Coquina layer made up of marine shells. They are quite distinctly divided into two layers or beds. The upper one averages about 3 or 4 feet in thickness; where undisturbed by recent stream beds or other excavation it is composed principally of alternating layers of rather coarse, loose sand, swamp-muck and leaf-mould, the muck deposits being heaviest at the top, the interstratified leaf-mould and sand layers prevailing in the lower portion of the upper bed. The lower bed is composed of a more compact and purer sand mass which shows little stratification, except in its lower portion, where there is some evidence of faintly defined alternating layers and lenses of coarser and finer sands intermixed in places with a sandy swamp muck. This geologic structure is almost identical with conditions observed at Vero. Hence in describing them I have used Dr. Sellards' designations of the three geological levels. The underlying shell deposit is known as "No. 1 bed," the lower sandy deposit as "No. 2 bed" and the upper one as "No. 3 bed."

In former explorations, excavations of very small extent were the rule, with occasional development of larger areas in which a complete section of the deposit was exposed and worked on a more or less perpendicular face. This method gave a good general idea of the structure of the beds but only such as could be studied in cross section. In consequence some wrong interpretations of the origin of the beds were made, and some important features of structure were overlooked.

For example, it was rather generally accepted that the unevenness of the contact plane observed between the No. 2 and No. 3 beds was due to stream-channel erosion, and that the deposits of both these beds were principally due to stream-channel action. On this assumption it was suggested that the entire deposit was of relatively recent origin, the presence of a more ancient fauna being accounted for by assuming that they were derived from worked over and redeposited older beds.



FIG. 9.—Country club golf course, Melbourne, Florida, showing area cleared for excavation. Young palmetto at left same as one in similar position in figure 10.



FIG. 10.—Golf links locality, Melbourne, Florida. Main pit looking northwest, showing basin-shaped depressions in surface of No. 2 bed.

It was also assumed that the entire deposit above the No. 1 bed was fossil-bearing. The process followed the past season consisted of working over the No. 3 bed first and stripping it cleanly from the contact plane before developing the No. 2 bed. In this way several important observations were made possible. These necessitate an interpretation of the origin of the deposits quite different from that assumed by Dr. Sellards and others, but they bring strong confirmation of Dr. Sellards' former view that the human remains found in the No. 2 bed indicate the contemporaneity of man with the fauna of that zone. These observations may be briefly stated as follows:

First, it was discovered that the upper or No. 3 bed is entirely of swamp and wind-blown sand origin, and that this bed where undisturbed by recent stream cutting is almost barren of fossil remains. This suggests that continued swamp conditions from the time of its beginning to the present have excluded land animals from the areas now covered by this deposit; also that man would probably not have made any burials there either during or since its accumulation. Furthermore the very nature of the beds, which are made up of sharply defined, alternating and interfingering layers of loose sand, swamp muck, and light leaf-mould, forms a very effective seal over everything below them, a seal through which it would be almost impossible to break by any kind of excavations and refilling without that fact being readily detected.

The second important conclusion reached after uncovering large areas was that the unevenness of the contact plane was not due to water erosion of any kind but was caused by more or less regularly basin-shaped depressions of varying sizes and depth. It was noted also that fossil remains of relatively recent appearance were found strewn over all this contact plane, with occasional association of human artifacts and fossil remains evidently worked out from the underlying No. 2 bed. The No. 2 bed was found to contain an unmixed extinct fauna from top to bottom. Most of the material was much broken, and many instances were observed of pieces of bones belonging to a single individual being scattered over several feet of area on the same level, indicating that the accumulation of this deposit had been gradual and almost undisturbed by the action of stream currents. The No. 2 bed seems to be mostly of wind-blown origin.

In this deposit at about mid-section was found this season an arrow point or stone knife of human origin, and a few years ago within a hundred yards of this spot was found a crushed human skull and a few scattered bones near the top, but entirely within the limits of the No. 2 bed.



FIG. 11.—Golf links locality, Melbourne, Florida. Arrow point in place at end of brush handle. View shows entire section of No. 2, No. 3, and recent beds.



FIG. 12.—Main pit, golf links locality, Melbourne, Florida. West side of pit, section through formations above No. 1 bed, showing recent cut and fill through No. 3 bed and into top of No. 2 bed. *Tremarcos* specimen was found in this excavated portion of pit in dark layer represented about 10 inches above coquina layer of No. 1 bed.

Thus Dr. Sellards' contention seems now to be confirmed, that man existed in Florida contemporaneously with an extinct fauna. The exact age of the extinct fauna, however, is somewhat uncertain and is still an open question. Some authorities consider it middle or early Pleistocene, but there are features connected with it which suggest a later phase of that period. Only better collections and a very critical study of all available material will satisfactorily solve this question.

As a part of the work accomplished by this expedition, the old locality at Vero was again visited and the similarity of conditions there and at Melbourne were verified. Also visits were made to other localities, the most important being Okeechobee and New Smyrna. At these places observations showed unmistakably similar conditions of sedimentation but in somewhat modified form. At New Smyrna the No. 3 bed was thinner and had a greater percentage of swamp-muck than at Melbourne and Vero, and the No. 2 bed is composed of a more compact and finer quality of sand. This bed contains abundant fossil bones, of the same characters as those of the No. 2 bed at Melbourne. Here also were found human artifacts and remains in undisturbed natural association with the fossil bones.

CAMBRIAN GEOLOGY OF THE ROCKY MOUNTAINS

By C. E. RESSER,

*Associate Curator, Division of Stratigraphic Palaeontology,
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Continuing my stratigraphic studies through which it is hoped ultimately to gain a clearer conception of the Cambrian system as developed in the Rocky Mountains, the past field season was devoted to a study of the Cambrian beds as exposed in some of Wyoming's larger mountain ranges. Again travel was by auto truck, which was frequently driven considerable distances beyond the end of the roads to more convenient camp sites nearer the outcrops. My son, Harold I. Resser, again acted as camp assistant.

After securing the auto truck and camp equipment at Salt Lake City early in July, we traveled northward through the picturesque Bear Lake and Star Valleys and entered Wyoming across Jackson Pass. A well-exposed section above Blackrock Meadows east of Moran gave us a good idea of the structure where the lava-covered Absaroka Plateau joins the better defined ranges that extend southward from this point. Following this, our attention was turned to the Wind River Range where, as at many other places, it was found difficult to reach the Cambrian rocks without the use of horses because these beds outcrop high up next to the granitic rocks of the mountain core, and further because some of the younger sedimentary rocks, which also dip away from the central core, are composed of massive limestones that confine the many vigorous streams coming down from the moist heights to narrow canyons walled in by unscalable cliffs. However, the recent building of roads to furnish outlets for lumber camps and "dude" ranches has made it possible at places to drive up over this sedimentary rim into the regions of less rugged relief beyond. Contrary to the usual rule that roads entering or crossing mountains should follow up stream courses, many of Wyoming's mountain roads take a totally different route, zigzagging up a spur between two streams until above the sedimentary rim previously referred to, and only then following a stream course. But even here the open, park-like landscape, with its relatively gentle slopes, permits the construction of roads almost anywhere; consequently scarcely any of the roads follow streams for long distances. Thus at Warm Spring and Torrey Creeks it was possible for us to get up to two fine sections, as we also did along the Atlantic City-South Pass road far to the south.



FIG. 13.—Camp of Wyoming Tie and Lumber Company, Warm Spring, Wyoming. A fine Cambrian section was studied on point of hill in center of view. (Photograph by Resser.)



FIG. 14.—Looking west down Teton Canyon and across Teton Basin in Idaho. Fine Cambrian section exposed in left wall. (Photograph by Resser.)

After this somewhat hasty examination of the Wind River Range, we crossed the Owl Creeks through the famous Wind River or Thermopolis Canyon into the Big Horn Basin. Two roads cross the Big Horn Range, whose structure, like that of the Wind River Range, consists of a granite interior surrounded with sedimentary rocks, which, since the uplift, form a band of varying width all the way around the range. Several sections were studied along these roads. In Tensleep Canyon, for instance, on the southern-most of these two roads, new construction has exposed the softer Cambrian beds here present, permitting their examination with ease. On the eastern side of the range where this highway goes down again across the band of sedimentary rocks, after having traversed many miles of the delightful upland region with its open granite topography, the section is so greatly disturbed as to be of little value except for checking observations made elsewhere along this front. We returned westward over the Big Horns along the northern route, or the Dayton-Kane road, getting the best exposure possible in coming up the eastern side where a new road was then under construction. Here a fine section and many instructive fossils were obtained. It was found that where the road drops down into the Big Horn Basin on the west, the section in Bald Mountain and the adjacent hills was not as cleanly exposed as expected, and consequently also yielded but few fossils. Here again the use of horses would have greatly enlarged the possible radius of activity and perhaps would have made it possible to reach the more fossiliferous beds reported to lie to the north in Sheep Mountain. Nevertheless many stratigraphic data of importance were obtained.

The latter part of the season was spent in the Teton Mountains, particularly in Teton Canyon. Here, as in many places in this and other ranges, the recent glaciation has steepened the slopes of the canyons to such an extent that the softer shale beds are frequently exposed on the slopes between the cliffs which the limestones and other massive rocks ususally form. In this place, almost directly under the Grand Teton, the scenery is so magnificent that one is constantly tempted to gaze upon it at the expense of considerable time. Indeed, I think it safe to say that scarcely any other mountain group in the world exceeds the magnificence of the Teton Mountains.

The Wyoming ranges afford many fine examples of the varied effects of glaciation. In the Tetons, cirques and U-shaped valleys are developed to text-book perfection, and in the Wind River Range, an icefield more than 20 miles long still sends down its floods of milky water. When a few warm days occur in succession in late July, melt-



FIG. 15.—Road through dense aspen grove in lower Teton Canyon.
(Photograph by Resser.)



FIG. 16.—At head of South Fork, Teton Creek. These ponies have come down the "Devil's Stairway" over the Cambrian cliffs to the right. Cap, a "thoroughbred colliaire," has an amusing habit of eating snow by scooping it up with his lower jaw. (Photograph by Resser.)



FIG. 17.—Looking north along axis of Wind River Mountains from South Pass road. Old stable for horses used in nearby mine stands on Cambrian rocks which make the slope to the right. (Photograph by Resser.)



FIG. 18.—View northeast across glaciated head of South Teton Creek, showing sedimentary beds at left and top of Grand Teton in center. (Photograph by Resser.)

ing this ice, Dinwoodie Glacier sends down enough water to raise the level of the Wind River sufficiently to prevent the driving of railroad ties, for which purpose this stream is used at that season.

Another interesting set of facts was observed by us this summer along the western boundary of Wyoming. This boundary is a mathematical line and consequently does not conform either to the topography or to the distribution of tillable soil, as it cuts across foothills, mountains or fertile valleys indiscriminately. The Teton, Salt River, and intervening ranges form a huge mountain wall, uninhabited and not easy to cross, at varying distances to the east of this mathematical line. Wherever the line cuts into the foothills of these ranges no one asks for a change, but where a segment of habitable land is left on one side or the other, agitation has recently arisen for a change in the boundary. Thus, in the Teton Basin a small sector supporting several dozen people extends into a tillable embayment about the mouth of Teton Canyon—an area, incidentally, that shipped 100 carloads of table-peas this fall. This small group of people must do all of their buying and selling and receive their mail in Idaho. Their trade is of no value to other Wyoming citizens and consequently their community needs for roads and other civic improvements are apt to be neglected. Consequently this group wants the state line curved east sufficiently to include them with the remainder of the Teton Basin in Idaho. On the other hand, south of the Snake River, Star Valley along the Salt River lies mainly in Wyoming with only the western fringe in Idaho. Here the smaller group wants the line curved westward to include them in Wyoming where they buy and sell commodities, and receive their mail. This situation clearly illustrates the geographic problems involved in the establishment of boundaries.

EXTINCT OCEAN-LIVING MAMMALS FROM MARYLAND

By REMINGTON KELLOGG,

Assistant Curator, Division of Mammals, U. S. National Museum

During Middle Miocene times a considerable portion of southern Maryland was submerged below sea level and an extensive estuary of the sea reached northward across the state. Conditions were favorable for the deposition of sediments such as clays and sands, as well as for the existence of large numbers of ocean-inhabiting animals. These animals lived and died, and their hard parts or skeletons found a resting place on the sandy bottoms where in the course of time they were buried by successive layers of sediments. Then conditions changed and much of this area was uplifted above the sea. Many of the animals that frequented this region disappeared and new ones took their places. And it is in these Calvert sands and clays that we are able to reconstruct from more or less fragmentary remains the life that existed there at the time this formation was being laid down. For several seasons past, the writer and Mr. Norman H. Boss have been engaged in searching the exposures of the Calvert formation in Maryland for remains of fossil pelagic mammals. These studies have been continued in cooperation with the Carnegie Institution of Washington. Sufficient material has been accumulated to determine the variety of types that frequented the sea covering this area during Miocene times. Additional material is still needed to interpret the structural peculiarities of some of these extinct water-frequenting mammals.

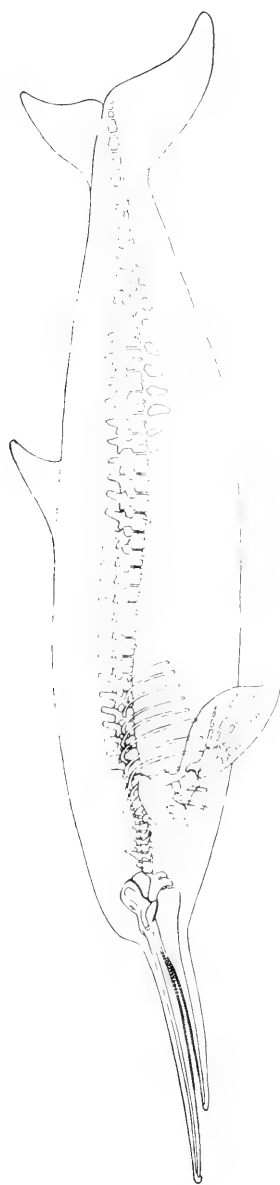
One cannot expect to find bones everywhere nor is it possible to search the surface of the entire formation, for much of it is buried beneath later deposits of earth. Along the western shore of Chesapeake Bay is an almost unbroken exposure of sandy clay known as the Calvert Cliffs, which extend southward from Chesapeake Beach for a distance of nearly 30 miles and in places attain a height of about 100 feet. The tides, the waves that rise in rough weather, and the storms, singly or conjointly are constantly cutting away the face of this cliff, exposing bones of animals that died and were buried in the sandy clays that comprise the Calvert formation. The waves cut away the foot of the cliff and thus undermine the exposed surface. Large blocks of the overhanging face drop off and these "falls" are soon washed away. In a relatively short time the bones that fall in the water are damaged or destroyed. For this reason the cliff must



FIG. 19.—Cliff along shore of Chesapeake Bay, Maryland, showing a fall of earth from which the man in the foreground is collecting fossil remains. (Photograph by H. S. Barber.)



FIG. 20.—Fossil-bearing cliffs along western shore of Chesapeake Bay, in which are found the bones of various sea-living mammals. (Photograph by H. S. Barber.)



TOTAL LENGTH—12 FEET

FIG. 21.—Restoration of extinct porpoise (*Eurlimodelphis bossi* Kellogg), which is based on fossil remains found in the cliffs along Chesapeake Bay, Maryland.



FIG. 22.—Skull and lower jaws of the type specimen of *Eurhinodelphis bossi* Kellogg. Collected by Norman H. Boss, 1918.

be inspected at regular intervals to save the bones that are exposed by the elements. Weather permitting, trips of one to two days are arranged for and these visits are extended if promising material is located. The last visit for the present season covered the period July 19 to July 22, 1928. On these inspection trips many interesting specimens have been found and brought to the museum.

Included among the fossil material thus acquired are the whole or portions of skeletons of at least 22 different kinds of whales referable to six families. This assemblage includes shark-toothed porpoises, sperm whales, both long and short-beaked porpoises, river dolphins, and several kinds of archaic whalebone whales or cetotheres as they are generally called. Remains of a small seal and a sea cow or sirenian have been found here.

One of the characteristic porpoises found in this formation of sandy clay has a skull with a long beak. Curiously enough, sockets for teeth are absent near the tip. Three specimens of another much longer-snouted porpoise with a skull nearly four feet in length have been found. Several other types of long narrow-beaked porpoises also frequented the Miocene seas that covered this area. The jaws of one of these are remarkably flattened. Another type has many long slender curved teeth. Judging from the known remains, sperm whales rarely visited this area and the predatory shark-toothed porpoises were less numerous than the supposedly fish-eating types. Several kinds of short-snouted porpoises have been found, and for two of these types almost complete skeletons have been collected. Most of the archaic whalebone whales are somewhat smaller than the smallest of the living finner whales, but the jaws of at least one type are as large as those of the recent Sei whale.

EXPLORATIONS OF THE REV. DAVID C. GRAHAM IN WESTERN CHINA

BY CHARLES W. RICHMOND,

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The Rev. David C. Graham, who has been exploring various parts of western China for several years in the interests of the Smithsonian Institution, resumed his work in the latter part of 1927, after a year of study in the United States. He and his Chinese collectors worked as opportunity offered in the vicinity of his headquarters at Suifu, in the Province of Szechuan, and upon occasion he sent them as far as Kiating and Yachow, to the north and west. This collecting resulted in the accumulation of over 11,000 specimens, consisting roughly of 1,000 vertebrates and over 10,000 invertebrates, all of which have now reached Washington and are in process of examination by the various curators. Among some non-zoological specimens sent in are 100 or more artifacts obtained from old burial tombs near Kiating in January, 1928. Dr. Graham writes that these tombs are of the Han Dynasty, though "popularly believed to be pre-Chinese caves formerly inhabited by the Mantsis or aborigines." His success in finding these artifacts was due to "the fact that the collecting was in a section that has been practically overlooked by Chinese and foreigners who were interested in collecting such materials in the past." The specimens include a variety of subjects, such as the "right front half of a small dog with a pug nose," "remnant of a face; has earrings and is evidently the face of a pretty woman," and "part of a hen with a chicken on its back." Referring to another specimen, Dr. Graham writes, "One box contains a Miao suit. . . . It has a story. The Miao boy brought his sister to Suifu to learn weaving. When the boy went away, the Chinese sold his sister as a slave. He was poor and could not get her back. By selling the garment to me for eight dollars he got just enough money to buy her freedom again. He says he will get me a much better garment later at a reasonable price."

During the summer season Dr. Graham has been in the habit of making extended trips to more remote parts of the province, and has visited Sungpan, Tatsienlu, and the mountain Washan on such occasions. For several years he has planned a visit to Moupin and vicinity, a locality of zoological importance through the work done there years ago by the Abbé Armand David, but each year he found that war,



FIG. 23.—Chinese caves near Kiating carved in the solid rock, formerly used as burial tombs. (Photograph by Graham.)



FIG. 24.—A farmer plowing with a typical Chinese plow and a water buffalo, near Kiating. (Photograph by Graham.)

brigandage, or strife of some kind made a visit impossible. This year he again looked forward to a trip to Moupin, but as spring advanced the news became increasingly unfavorable and by the latter part of June he gave up hope. The Chinese were at war with the Lolos, a native tribe, and the latter had cut bridges and fortified various strategic points, and a peaceful expedition through this region was out of the question. However, in the event that the trip to Moupin failed, Dr. Graham had picked out Ningyuenfu as a place worthy of



FIG. 25.—The Smithsonian expedition on the way to Ningyuenfu, Szechuan Province, China. Taken in a mountainous district where Lolos constantly rob the travellers and where a good escort is a necessity. There are 14 coolies, 3 native collectors, 15 soldiers, a yamen runner or representative, and D. C. Graham.

investigation, so he adjusted his plans to fit the needs of that place. In referring to this change of plans, after making his summer expedition, he writes, "The next best trip possible was to Ningyuenfu, 12 days journey south of Yachow, so there I went. Robbers were legion west of Yachow until we reached the region of the Lolos. Then there was constant danger from attacks by Lolos. West of the Great Shiang Lin Pass there had been no rain for more than a month, and this made collecting more difficult. At Ningyuenfu the officials put up placards telling hunters to bring in game to sell to us, but not a single thing was brought in. Because of the raids of the Lolos it was im-

possible to go to the mountains even near by to hunt. While we were at Ningyuenfu, Lolos attacked a caravan, carried off pack animals and goods, and took off some Chinese as captives. I do not think that conditions in the Ningyuen district can improve much for a good many years."



FIG. 26.—An unusually beautiful archway spanning the main road west of Uin-Gin-Shien, Szechuan, China. This is a memorial arch erected in memory of a widow who remained loyal to her husband after his death by never remarrying. (Photograph by Graham.)

Ningyuenfu is scarcely more than 150 miles southwest of Suifu in an air line, but the road leading to this place required a long journey, via the Min River to Kiating, thence along the Ya River to Yachow, after which the general direction lay to the south. The expedition started from Suifu on July 4, with 10 coolies to carry the loads, two or three native collectors, a cook, and an escort. On the 5th, Dr. Graham remarks in his diary, "we passed through a robber resort,

which was quite peaceful to-day because the militia had made a raid and executed one of the robbers. We saw the dead robber being carried home, escorted by his wife and others, to be buried after the priest has performed the long ceremony of opening the way to hades. His blood had sprinkled the roadway for at least a half mile." The party crossed the river five times on July 6; the weather was very hot, and the coolies were fagged out. One of them suffered a sun-stroke and was obliged to return to Suifu. The party reached Chien-way (or Kienwei) after dark, and here the escorts were changed. On the 7th, another hot day, two coolies ran away, rather than continue the journey. One hundred and twenty li (about 35 miles) were covered on this day, the party reaching Kiating, where they remained on the 8th, to give the coolies a chance to rest. A heavy rain made the roads very muddy, but they were ready to resume the trip on the 9th, though delayed in starting. As a result of the delay the party made only 70 li, but reached Kia-Kiang.

On the next day they had an escort of 10 men with rifles, as the danger from brigands was increasing. Yachow was almost within reach on the 11th, but muddy roads prevented them from arriving there until the morning of the 12th. Here Dr. Graham arranged for the military escort, bargained for coolies to continue the trip, packed up specimens to be left at Yachow, and repacked parts of his outfit. The journey was continued on July 14, when the party traveled 90 li to Ün-Gin-Shien, over the Gi-Tsi-Gang Pass. At the summit of the pass they saw the head of a robber, set up as a warning to others. Next day only 40 li were covered, for the travel was uphill and the weather very hot. Conditions improved on the 16th, when they reached higher levels and crossed Da-Shiang-Lin Pass (altitude about 9400 feet). A band of robbers had been operating in the pass in the morning, but had disappeared when the party with ten soldiers reached it in the afternoon. Later, Dr. Graham learned that the bandits had retreated only to let his armed party pass and had returned and robbed others the same day. The next day was extremely hot, but the party made 80 li and reached Fu-Lin, where the altitude was about 3400 feet. On July 18 they crossed the Tung River in ferry boats, and Dr. Graham remarks in his diary that "the yamen officers delayed us three whole hours in doing what could have been done in ten minutes." He also notes that on the top of a pass he saw "in a basket on a pole the head of a robber who had robbed and killed a postman. The magistrate used this method to warn others." For the next two or three days travel was much the same as that previously experienced,



FIG. 27.—Smithsonian expedition crossing the river at Fu Lin in Chinese boats, August 15, 1928, on the way back from Ningyuenfu. Notice that the ends of the boat turn up—this is not true on the Yangtse and Min Rivers.



FIG. 28.—Part of the Smithsonian expedition crossing a bridge near Fu Lin, Szechuan, China, August 15, 1928. (Photograph by Graham.)



FIG. 30.—Group of mixed-blood Lolos at Fu Lin, Szechuan, China. The two men in front are dressed like typical Lolos. These mixed-bloods are part Lolo, part Chinese, and are called white-boned Lolos. Note that some of them have their hair braided into a knot on top of the head. This symbolizes the God of Heaven, the only god the Lolos worship, called Tien Pusah in China. (Photograph by Graham.)



FIG. 29.—Mr. Li, head of the Li clan of 300 families, full-blooded Lolo, wearing the armor handed down by his ancestors. All the armor but the long spear has been purchased by D. C. Graham for the Smithsonian Institution. The arrow is a poisoned arrow. (Photograph by Graham.)

up hill, over passes, and down again. On the 21st, Dr. Graham observes that "a Chinese woman, evidently in much mental distress, knocked her head on the ground and told me that three of her children were captives among the Lolos (or Nosos). She had no money to ransom them." At the time he was writing this note, the Lolos attacked the village, but his escort, now increased to 15 men, helped to repulse them. The Lolos are a fierce aboriginal tribe who seem to live largely by plunder. The pure Lolos call themselves "black-boned," to distinguish them from those who are part Chinese and are known as "white-boned." Dr. Graham does not indicate the meaning of this distinction, except to say that the "black-boned" Lolos are the elite of the tribe.

On July 23 the party crossed a pass called by the Chinese Shiao-Shiang-Lin, with an altitude of 10,800 feet. This pass was feared more than any other one yet to be reached, for at this one the Lolos rob, loot, and take captives, while at the next one Chinese are the robbers. The 24th was uneventful, except that the party passed through a Chinese village that had been looted, the houses burnt, and the people taken away as captives by the Lolos. Some of the captives had been ransomed but others were still in captivity.

At some periods of the journey the Graham party numbered 34 souls, but by this time it was reduced to 18. Dr. Graham and his collectors added to their natural history material at every opportunity, although conditions were not ideal for the gathering of specimens. The party reached Li-Tseo on July 25, and spent the night there. They were still 50 li from Ningyuenfu but reached their destination on the 26th.

Some days were spent at Ningyuenfu, where Dr. Graham and his assistants collected specimens, particularly on a lake in the vicinity. On July 28 several members of the party went on a short trip and the head coolie cooked dinner. He used some "salt" on the vegetables which proved to be arsenic, and all those who partook of this food were made sick, but fortunately all recovered. On August 1, Dr. Graham mailed 16 boxes of specimens to Suifu as being a more certain means of getting them through in safety.

The return journey was begun on August 6, and was largely a repetition of the outgoing trip. Dr. Graham notes in his diary that all of his coolies were opium smokers, and that it was a problem every morning to get them up in time to smoke their opium and get an early start on the road. On the 10th he writes they passed many ruins of towers and fortresses, and that nearly every town was walled, all



FIG. 31.—The coolies who carried the Smithsonian baggage from Ning-yuenfu to Yachow. Every one but the head coolie, who is better dressed and near the center of the front row, is an opium smoker. (Photograph by D. C. Graham.)



FIG. 32.—Taoist priest begging along the roadside near Yachow. He is securing sympathy by reading the Taoist scriptures. In the rear can be seen coolies carrying Smithsonian loads. (Photograph by Graham.)

as a protection against the Lolos. He could get only four escorts from the military authorities on the 12th, so went to the civil magistrate and got four more. His collectors were not permitted to collect insects outside the city gates at night because of the activity of the Lolos, who had burned more than 10 houses in the vicinity the day before, besides pillaging and committing other depredations. The party reached Fu-Lin on the 15th, and several days were spent here at the home of a friendly Lolo. Through the help of this man Dr. Graham was enabled to make some anthropometric measurements of pure-blooded Lolos, and also obtained two sets of Lolo armor that may be 200 years old. The party made a hard trip across the Da-Shiang-Lin Pass on the 24th, with an escort of 23 soldiers. After crossing the pass they were met by soldiers from the east side of the mountain who accompanied them to Huang-Li-Pu. On August 25, he notes in his diary that "yesterday nearly 100 brigands robbed a caravan and the brigands were pursued by soldiers and militia, the battle continuing until about noon to-day." He arranged for a good escort to Yachow, and secured 23 soldiers with rifles. The party reached Yachow in safety on August 26, and Dr. Graham settled with his coolies and did some repacking. He secured a raft for the trip to Kiating, and got one that was about 14 feet wide and 75 feet long, made of 25 bamboo poles placed side by side and strapped together. The raft trip was begun on the 28th, but had not proceeded far when four men (two with rifles) ordered the party to come ashore. After some parleying with the strangers the party got beyond reach and escaped. Kiating was reached on August 29, and Suifu on September 2. In the course of his summer expedition Dr. Graham covered over 800 miles of the distance on foot.

The material collected on the Ningyuenfu trip has been packed and shipped, but at the time of writing this report (December 19) it had not yet arrived in Washington. Dr. Graham writes of this expedition "The Ningyuen trip has in some ways been the hardest, most dangerous, and most disappointing trip that I have yet taken. I sincerely hope that the Smithsonian Institution will find the collection worth while."

EXPEDITION TO SAMANÁ PROVINCE, DOMINICAN REPUBLIC

By GERRIT S. MILLER, JR.,

Curator, Division of Mammals, U. S. National Museum

AND

HERBERT W. KRIEGER,

Curator, Division of Ethnology, U. S. National Museum

The northeastern portion of the island of Haiti comprising the peninsula and bay of Samaná with its many islets has long been known as a region rich in deposits left by its pre-Columbian inhabitants. On the south shore of Samaná Bay, which deeply indents this coast of the island, Gabb explored some caves in 1869-1871, and found them to contain very extensive kitchenmiddens. Pottery and bones collected by him have been in the National Museum since 1872. Among these bones were found, early in 1916, some jaws of a rodent supposed at that time to be extinct. Stimulated by this discovery, Dr. William L. Abbott visited the caves later in the same year. He obtained material of great interest and reported that large accumulations of shells, bones, and pottery remained to be examined. With the chief object of working these deposits more carefully than had hitherto been done, the writers of this article spent several months, during the winter and spring of 1928, in exploring that part of the Dominican Republic which includes Samaná Bay and the peninsula that lies between the northern shore of the Bay and the Atlantic Ocean. The combined objectives of the expedition were to recover animal bones and cultural remains from shell heaps, kitchenmiddens and aboriginal habitation sites, and to make general collections of the plants and vertebrates of the region. From all points of view the work was satisfactory. Detailed study of the rich collections obtained cannot fail to throw new light on the remarkable extinct or nearly extinct mammal fauna of the island and on the history and culture of the Indians who occupied the region before the arrival of the Spaniards.

Working from the town of Santa Barbara de Samaná as our base we first crossed to the caves on the uninhabited south shore of Samaná Bay. It was easy to reach the south shore by a brisk two and a half hours' sail with the favorable afternoon trade wind, but the return trip during the morning calms or against the trade wind was a more serious undertaking. On one occasion it required 10 hours of tacking



FIG. 33.—Leaving Samaná for the caves located on the opposite shore of the bay, 15 miles to the southwest.



FIG. 34.—Coast near the Boca del Infierno cave, showing elevated line of wave cutting.

and sculling. Living quarters were established in one of the larger caves of the Playa Honda coast locally known as "Boca del Infierno," the Mouth of Hell. Except for annoyance caused by the small sand flies, living in the cave was pleasant enough, as the cave floor was dry and the entire cavern well ventilated. Three main openings, two of which faced the bay, and several large openings in the roof caused by the fall of rock masses loosened by water seepage, were not sufficiently large to allow daylight to penetrate the entire cavern. Recourse was had to artificial lighting, in which a curious collection of electric lanterns, flashlights, paraffine candles, kerosene lanterns, and candlewood torches each played a part.

The cave selected as the expedition's headquarters had several compartments, one of which served as packing room and laboratory, others as dormitories. The laboratory was also used as kitchen and dining room. At mealtime the bottled lizards and the plant presses were removed from the packing box work table and were replaced by kidney beans, rice, fish, and Dominican coffee roasted to a crisp in sugar, pounded to a powder, and boiled interminably. The merits of native Dominican coffee thus prepared may well be remembered if not appreciated.

Abraham Lewis, a St. Kitts negro long established near the town of Santa Barbara de Samaná, with his two helpers, one a Dominican, the other a deep water English negro sailor from Jamaica, operated the small and none too comfortable sailboat which was our only means of communication with the outside world. The desire to work for the Americans was so great that Abraham, in order to accommodate his friends, was compelled to change the crew each week. This novel form of labor turnover proved somewhat annoying to us, but it had to be put up with for the good of the expedition.

No fresh water was found in any of the caves explored, although a small quantity of water saturated with carbonate of lime dripped from the cave ceiling at many points. This water, because of its lime content, was not potable, but apparently it had been used by the aboriginal occupants of the caves, as shards of broken earthenware vessels and a few unbroken bowls were picked up from the floor of the caves near the stalactites. These shards were coated with carbonate of lime and were not recognized as earthenware fragments until the lime incrustations were removed. Streams of good fresh water at places flowed from the base of the cliffs in the narrow ravines. The nearest of these streams was two miles away from our cave, and from it our water supply had to be brought by the sailboat

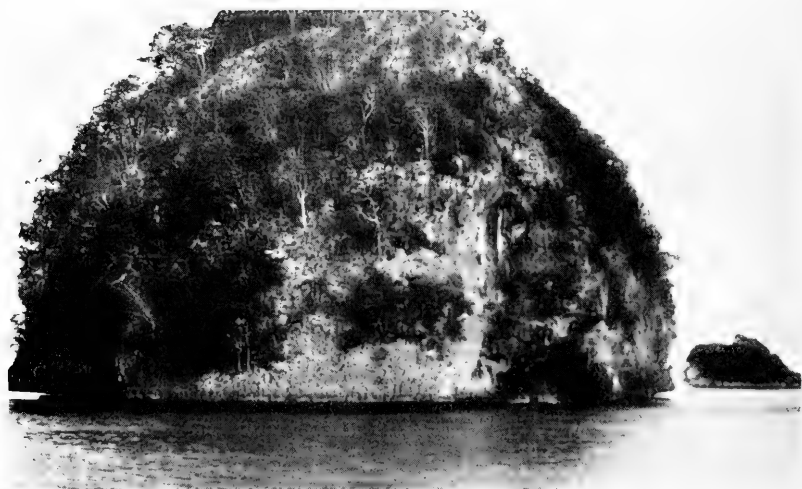


FIG. 35.—An undercut key near the Boca del Infierno cave. A colony of frigate birds was nesting on the small key at the right.



FIG. 36.—San Gabriel Island, near the Boca del Infierno cave. This island contains a large cave in which we found extensive Indian shell heaps.

in carboys and gasoline cans. We were plentifully supplied with fish by Abraham and his crew who sank several fish pots of plaited bamboo strips in the shallow water of the small bay on which our home cave opened. The fact that fish nets had been woven and employed by the pre-Columbian Indian occupants of the caves, was evidenced by the recovery of several net weights of notched stone from the middens near the cave entrances.

As the "staff of life" of the prehistoric cavemen consisted essentially of the meat of the conch and other shell fish, it is of interest to note that we were unable to find a bed of live conchs, although careful search was made at various points. Natives professing to know of such beds were never able to locate one although a small number of recently dead conch shells of the same species (*Strombus pugilis* Linnaeus) as those of the cave deposits were found in one of the shallow coves near the keys. The absence of beds of live conchs is remarkable, as the bulk of the midden material covering the cave floors is made of these shells.

The floor of the caves is covered with a thick layer of reddish-yellow soil. The soil is exceedingly fine grained and compact, not at all sandy. Upon this stratum rests the layer of aboriginal kitchen refuse. This layer is of irregular depth, greatest near the cave entrance, but sloping down to isolated heaps at a considerable distance away.

These kitchenmiddens contain conch, clam, and other species of shells, crab claws, mammal, fish, turtle, and bird bones cast there by the pre-Columbian Indian cave dwellers. The bottom of the deposits of shell is embedded in the yellowish soil, while the upper sections are interspersed with deposits of ash, charcoal, and a small quantity of artifacts, such as shell utensils, shards of broken pottery, and implements of flaked stone.

Above the Indian layer lies a deposit varying from a few inches to two feet in thickness belonging to recent historic times. This upper culture layer is nondescript in the extreme and includes such objects as fragments of pig, cow, and other animal bones, as well as coconut and calabash shells. Tools of iron including a Spanish ax were recovered from the vicinity of improvised fireplaces. Some of the more habitable caves are still occupied at times by Dominicans who come to the south shore of the bay to tend their fish pots, and to work in their small potato, coconut, and banana plantations. One large cave at the head or western end of the bay near the mouth of the Barracote River is occupied in season by a number of "mangle rojo" or tanbark



FIG. 37.—Our camp in the Boca del Infierno. This cave was inhabited by the pre-Columbian Indians.



FIG. 38.—Going to the San Juan village site.

peelers, who work in the mangrove swamps during the day and find the cave shelter a satisfactory domicile at night.

Covering much of the interior floor of the caves are large deposits of guano which were many years ago extensively exploited for use as fertilizer. The removal of guano disturbed some of the culture deposits which in several instances had been removed along with the guano. This commercial use of the cave deposits greatly hampered our scientific investigations.

Deposition of shells in the kitchenmiddens had produced heaps of varying thickness; but in those portions of the caves, usually near the entrances, which were obviously devoted to culinary purposes, the refuse heaps reached a thickness of nine feet or more. Where the deposits had not been disturbed or removed in part by collectors of fertilizer, excavation and systematic study of the refuse heaps was undertaken. Obstructions due to fallen rock were negligible as the environs of Samaná Bay appear never to have suffered much from destructive earthquakes. Only a few broken stalactites were observed.

As pointed out before, surface finds were distinctly post-Columbian, while extensive middens containing rude artifacts of shell and bone, and of flaked stone were identical throughout. No stratification showing definitely marked differences in the culture remains were noted except in one instance. This one exception was a clearly marked break in the deposits of the cave on the mainland just east of the abandoned railroad track about two-thirds kilometer inland from the shore of San Lorenzo Bay. Here was found a layer, composed of clam and oyster shells interspersed with mammal, bird, and fish bones and with crab claws, forming a deposit of an average thickness of three to five feet. As excavation continued, there was found underneath this layer a stratum of black loamy soil approximately eight inches in thickness. Beneath this deposit of soil was another culture deposit four to six feet in depth which included mostly conch shells and practically no animal bones. Crude, characteristically pre-Ciguayan implements of shell, bone, and of flaked stone were recovered from this lower culture deposit, while pottery shards, some of which were decorated, and pottery food bowls were recovered from the upper culture deposit.

The stratification here revealed appears to indicate that the cave had been abandoned by the conch eaters to be later reoccupied by aborigines having a preference for clams, and in general for a diet including a variety of animal food. These later pre-Columbian cave dwellers possessed a material culture approximating that of the



FIG. 39.—Samaná from the harbor.



FIG. 40.—Cultivation on the San Juan village site.



FIG. 41.—On the highway to the San Juan village site. The step-like ridges are made by the pack-animals' feet in wet weather.



FIG. 42.—Excavating in the garden which now occupies the San Juan village site.

Ciguayan Indians who formerly occupied the north shore of Samaná Bay and who gave battle to Columbus when he entered the bay to observe an eclipse of the moon and to take on fresh water before returning to Spain to report his discovery of the New World.

After completing investigation and exploration of the caves, we began the excavation of two Ciguayan village sites on the north shore, that is, on Samaná Peninsula. The Ciguayan village site at Anadel, a point two kilometers east from the town of Santa Barbara de Samaná on the north shore of Samaná Bay, was worked first. The next project undertaken and the last of the season's work was the uncovering of the ancient village site of the Ciguayan chief Mayobanex at the mouth of the San Juan River on the north coast of the peninsula, about 10 kilometers due north of the town of Santa Barbara de Samaná.

Anadel is but two kilometers distant from Samaná, so that it was unnecessary to make camp at the village site. Living quarters were established at Hotel "Bequi" in Samaná. Becky (Bequi) is the daughter of an American negress who emigrated from Philadelphia in 1820. A large number of descendants of American negroes from Boston, Baltimore, and Philadelphia still live on the peninsula in the vicinity of Samaná. These negroes remain more American than Dominican, although their old revival hymns are translated into Spanish, the language of the country.

The Ciguayan village site at Anadel covers roughly a tract of five acres although only a small portion of the site was found suitable for excavation. A large quantity of cultural material consisting of implements of shell, stone, and bone, and of decorated pottery, together with mammal, fish, and bird bones, was collected. Work was continued here for a period of three weeks. Artifacts from Anadel and from the upper culture stratum of the "Railroad" cave on the mainland of the south shore are sufficiently similar to justify an assumption of tribal identity for the later aboriginal occupants of the caves and the Indians who occupied Anadel. Such identity in types of artifacts does not apply to the lower culture stratum from the caves. This clearly belongs to a pre-Ciguayan population.

The most extensive Ciguayan village site explored is that located at the mouth of the Rio San Juan. The valley of the San Juan River is accessible by horse and bullock transportation only, as there are no roads suited to wheel traffic. There is a deep rich soil and the clumps of bamboo and tiny banana or plantain gardens become more numerous as the valley broadens out near the mouth of the stream and the



FIG. 43.—His Excellency, the Governor of the Province of Samaná, Dominican Republic.



FIG. 44.—Señor and Señora Aybar of Samaná. Señor Aybar was of much assistance to the expedition in his capacity of Collector of Customs.

north shore of the peninsula. The hills here become rougher and more picturesque. Gabb, who was there in 1869, says that the valley is "as wild a spot as can well be imagined; a long sand beach, ending abruptly against a high bluff of black rocks, with the broad Atlantic thundering against it with a ceaseless roar." In the sixties when Gabb visited this region the only settlement consisted of two huts. The Smithsonian expedition found several squatters and tenants occupying the area, but no systematic attempt at settlement and agriculture anywhere in the valley. The peninsula as a whole is undeveloped and is almost entirely covered with native forest. If we are to judge from the size of the midden at the Indian village site at the mouth of the San Juan River, agriculture on the peninsula in pre-Columbian days was more extensive than it is now.

While we worked this site we established living quarters at the Finca de la Esperanza, an abandoned cacao plantation picturesquely located among the mountain ridges which traverse the entire length of the peninsula. The finca was well adapted to our purposes, being healthfully located in a region high above the mosquito and sand-fly infested coast. Each morning the long journey down the mountain trail to the coast was made on the backs of the rather ill-tempered diminutive stallions belonging to our patron and guide, John King. The more powerful but no less sure-footed bulls carried our collections of pottery, natural history specimens, and occasionally even a member of the expedition back to the finca in the cool of the evening. The success of the expedition depended in no small measure on the skillful conduct of our menage by Mrs. Miller, who not only planned our meals and managed the native cooks and other servants, but also acted as official translator for our party.

FURTHER EXPLORATION OF HAITIAN CAVES

By ARTHUR J. POOLE,

Aid, Division of Mammals, U. S. National Museum

In caves near St. Michel, Haiti, rich deposits of bones of extinct animals were discovered in 1921 by members of the U. S. Geological Survey, and in 1925, Mr. Gerrit S. Miller, Jr., curator of the division of mammals, U. S. National Museum, spent about six weeks in Haiti exploring these caves. Owing to lack of time the caves visited by Mr. Miller were only partially worked, and after his return, when the material obtained was worked over and identified, it was found to be of such importance in linking the faunas that had already been found on neighboring islands as to warrant sending a second expedition to the group of caves located near St. Michel. This second expedition was made possible through the generosity of Dr. W. L. Abbott, who has spent several years making biological collections on the various islands of the West Indies, including Haiti.

In order to visit as much of Haiti as possible, I obtained passage on a freight steamer that touched at five of Haiti's seaport cities. On December 8, 1927, we arrived at Cape Haitien on the north central coast, the second largest seaport and city in Haiti. Here we were allowed to land, and I spent several hours visiting places of interest and incidentally picking up a few miscellaneous specimens. During the night we arrived at our second stop, Port de Paix, situated near the northwestern corner of the island. On the following morning we made our first stop on the western coast at the seaport town of Gonaives, the third largest city in Haiti. It is in Gonaives harbor that sections of the Atlantic fleet make their headquarters during the winter maneuvers in and around Guantanamo Bay. Most of the day was spent visiting places of interest and gathering data to be used later in making collections. In the evening of the 9th we arrived at St. Marc, our fourth port, but did not have an opportunity to visit the town. St. Marc is headquarters for the Haitian cotton crop, and has one or two large factories for the manufacture of cotton-seed oil. On the 10th we arrived at Port-au-Prince, the capitol and largest seaport. Here five days were spent making final arrangements and getting together necessary supplies for the three months of collecting in the interior.



FIG. 45.—Type of houses used on the Atalaye plantation by the manager and his assistants.



FIG. 46.—Beautiful native village of Don-Don situated midway between San Rafael and Cape Haitien.

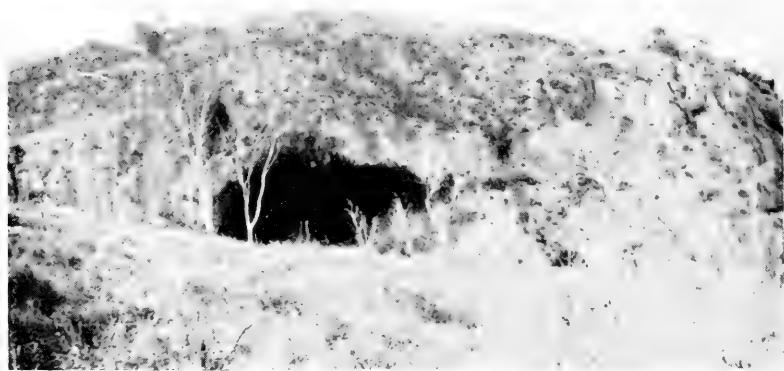


FIG. 47.—Entrance to cave at San Rafael.

On December 15 I arrived at the United West Indies Corporation plantation at L'Atalaye, 156 miles by automobile north of Port-au-Prince. Here I was made welcome and comfortable, being given a portion of the house occupied by one of the assistants to the general manager of the plantation. After spending a few days looking over the grounds and collecting specimens of various kinds, work was begun at the Atalaye group of caves known as Nos. 5, 6, and 7. These caves, situated on top of a limestone ridge, were about 45 minutes' walk due north from the plantation. All three of them had rather large openings, with masses of broken rocks strewn in the entrance. The floors in this group of caves all sloped downward, to a depth in some cases of about 50 feet below the level of the entrance, and consisted of a mixture of surface soil, guano, and small rocks. In some sections of the floor the soil had become quite solid through infiltration of lime in the water constantly dripping from the stalactites. Shortly after my arrival at the plantation I employed four young natives; fortunately, two of these had previously been employed by Mr. Miller and were somewhat experienced with this particular type of work. By December 21 operations were in full swing, starting with No. 5. Collecting of this nature was rather slow and tedious. First the larger rocks had to be removed, then the soil very carefully taken up and put through a quarter-inch mesh sieve, and from there screened into a very fine mesh sieve, in order to catch all the smaller bones, fragments, and tiny teeth. The large and medium-sized bones were then picked out and the residue placed in small sacks, which were later very carefully sorted at my headquarters on the plantation. The small skulls, jaws, and unbroken bones were then thoroughly cleaned, painted with a solution to prevent further breaking, and finally packed for shipment. Six days were spent in No. 5 with but only fair results.

I had been informed of another cave about 15 miles to the north, near San Rafael, and on December 28, made a trip there to inspect it. This cave was rather high up on the mountain side, with an entrance about 40 feet wide. The ceiling was very high in most places and the entire floor, unlike the other caves in which I later worked, sloped upward instead of downward. Large stalactites and stalagmites were abundant, many of them making excellent roosts for owls. Bats were numerous in this cave, but were concealed in the high fissures of the ceiling. Remains of bats, rats, and mice were fairly abundant on certain sections of the floor, especially under the "roosts." No collecting was done here at this time. One very large stalactite in the San Rafael cave took the form of an angel in flight, and this the



FIG. 48.—Every day is wash day with the natives. This girl is pounding clothes in a stream-bed.



FIG. 49.—Ring in which cock fights are held. This apparently is Haiti's national sport, as it may be seen in every village or hamlet.

natives worshipped as a saint. At the base of many of the stalagmites were crude carvings of faces, and occasional ones had legs and arms attached to the body. In almost every cave these stalagmite masses, with their carvings, were used as shrines for worship. Many coins of small denomination were found which had been placed in tiny crevices or buried in pits on the face or side of these shrines. Various articles of food and gourds were usually placed on or near the base of the shrines as an offering. In five of the eight caves in which I worked were shrines and carvings, all of which showed evidence of recent use.

On December 29 I visited the second group of caves known as the San Francisco group consisting of three separate caves. The largest one, having two openings at the top, was divided for working purposes into two sections. These caves, numbered 1, 2, 3, and 4, are situated about three miles to the west of L'Atalaye and about one mile east of the village of St. Michel, and are all fairly well up on the side of the limestone ridge, but not on top of the ridge as were the Atalaye group. Cave No. 1 which had an entrance only three feet in height by five feet in width, opened up into a fair-sized chamber about 50 feet long and 40 feet wide. The ceiling was quite low, and the bats did not appear to be as numerous as in some of the other caves with higher ceilings. It proved, however, to be the best cave in variety and value of material. Here we excavated the entire floor to a depth of several feet. The greater part of the material was found near the base of the walls, at depths of only a few inches below the surface to about three feet. Besides the numerous animal bones, human remains were also found here. The place of worship in the rear of this cave differed somewhat from those in the others. The loose rocks from the floor had been piled up on a protrusion of rock, and on and around these rocks were placed many things as offerings, such as hens' eggs, gourds, plantains, oranges, and small coins. Native-made candles were burned on these altars. About two weeks were spent in completing work in this cave.

On January 16 work was started in No. 2, the largest one of either group. This cave had a much more spacious entrance and two large openings from the top, one near the entrance, the other at the rear. It extended back about 175 feet with a width varying from 50 to 80 feet; the ceiling low in front and rear, but high in the middle, some of the fissures being about 100 feet in height. Most of the ceiling had the appearance of a huge honey-comb. Bats were more plentiful in this cave than any of the others. The floor was quite level except for pits caused by the removal of guano. Most of the time during



FIG. 50.—Bread market, San Michel.



FIG. 51.—Section of wall of the famous Citadelle from the inside. The Citadelle was built by Cristophe, once emperor of northern Haiti, as a final stronghold against the French.

my work here a large crew of natives were taking out guano for use on the plantation, some 600 tons being removed during the season. This cave also proved very productive of animal bones, and as in most of the others, the best material was procured near the base of the walls, or at the base of the huge stalagmite columns that extended nearly to the ceiling. Just inside and to the left of the entrance were a series of stalagmite columns, behind which were found large quantities of human remains, together with remains of the extinct small mammals. Occasionally the bones were in a charred condition, indicating that fires were built on the floor of the caves. In this cave were several "shrines" for worship. The work in No. 2 occupied two weeks.

Work was started on February 2 in the second deposit of Cave No. 2, which for working purposes only we have called deposit No. 3. The floor was similar to that of No. 2 except that it contained more natural soil and less guano. A fair-sized collection was obtained under about the same conditions as the previous ones. About 10 days were spent in completing this cave.

No. 4, the smallest cave in which I worked, was practically depleted of mammal remains by Mr. Miller on his visit there in 1925, and the one day spent in this cave produced very little material.

On February 13, in company with Lieuts. Thomas and Barwick of the U. S. Marine Corps and Mr. J. B. Lea of the United West Indies Corporation, I set out on the mountain trails for a visit to the famous Citadelle. Two days and nights were spent in and near the Citadelle, where general biological collections were made. About midway between San Rafael and the Citadelle we passed through the beautiful native village of Don-Don, situated on the edge of the Dorée River, one of the largest rivers in Haiti, and at the base of a high and heavily forested mountain. Upon my return, two days were spent in preparing and packing material collected in the St. Michel group of caves. Operations were then resumed in the Atalaye group beginning with Cave No. 7, which proved to be very successful. This cave was about 50 feet in depth and very steep, with large masses of broken rock occupying a great part of the entrance and floor. Most of the material collected here was of a smaller variety, chiefly bat skulls and insectivore jaws. About 30 gallons of finely sifted material were brought back from this cave unsorted, teeming with very small mammal, bird, and reptile remains, together with small shells. The work in this cave occupied about 10 days. No. 6, which was next in order, took very little time to complete, as most of the soil which it

once contained had been removed for fertilizer, leaving little but rock fragments.

On March 3 I left the plantation for a three days' trip to Cape Haitien where I was a guest on the National Tobacco Company's plantation, managed by Mr. E. J. Seager. Here a fair-sized collection of the reptiles of this region was obtained.

Three days' work in Cave No. 5 produced only fair results. In the cave at San Rafael a large series of jaws of a small insectivorous mammal were obtained, together with other mammal and bird re-

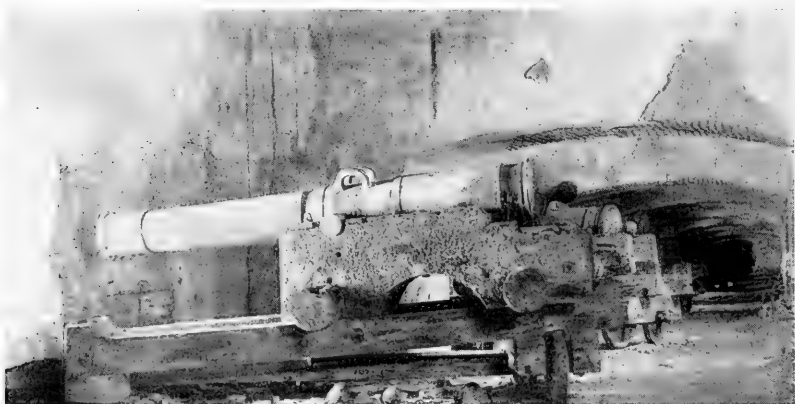


FIG. 52.—Old cannon in the Citadelle.

mains. One day was spent at Diquini Cave, situated about four miles south of Port-au-Prince, where a few specimens were secured, and on March 21 I sailed for New York.

The success of this expedition was due largely to the kindness of Dr. G. F. Freeman of the Service Technique, who furnished transportation facilities from Port-au-Prince to L'Atalaye; Colonel Myers of the U. S. Marine Corps; Mr. G. G. Burlingame, president of the United West Indies Corporation, who extended the hospitality of the plantation at L'Atalaye; and to Mr. Henry Morales, manager of the plantation at L'Atalaye, who rendered assistance during my entire stay in Haiti.

THE BEACH ANGLO-EGYPTIAN SUDAN EXPEDITION

By W. L. BROWN,

Chief Taxidermist, U. S. National Museum

In January, 1928, a party of big game hunters consisting of Mr. and Mrs. William Beach, Mr. Marcus Daly, and Mr. Osgood Field, sailed for the Anglo-Egyptian Sudan, Africa, and it was my good fortune to accompany the expedition as a representative of the Smithsonian Institution. Sailing January 4 from Hoboken, we arrived at our base, Khartoum, just three weeks later. Although desert-beset, this is a most beautiful city, for we find shady palm groves and lovely gardens of poinsettias, zinnias, roses, and other gorgeous flowers. A strange feature of the landscape here is the fact that the very large trees have the smallest leaves and the smallest trees have the largest leaves.

Next door to the Grand Hotel, where the party stopped, is the Zoological Garden, which contains many interesting specimens of animal and bird life. Some of the animals, such as gazelles and antelopes, and the larger birds, are allowed to roam at will over the garden. Here I saw the rarest sight that I shall probably ever see—a group of seven shoe-bill storks. Had I visited the garden on the previous day I should have seen eight instead of seven, for the assistant game warden told me that on the day before, one of them had gotten into the elephant pen and had been stepped on by the big pachyderm.

We remained in Khartoum five days, securing permits to hunt and awaiting our boat, the *Lord Cromer*, which had been chartered by the party from the Sudan Government for use as living quarters during the hunt. It was about 100 feet long, and was manned by a crew of Egyptians and native Sudanese.

Leaving Khartoum February 1, we traveled about a mile up the Blue Nile and then entered the White Nile. For a day and a night we passed through the Nile "sudd," an uninteresting and tiresome journey. By sudd is meant the enormous growth of papyrus and other aquatic plants encroaching upon and partly obstructing the river. No animal life can be seen here—only high walls of the vegetable barrier. During the rest of the journey up the river to Rejaf, the headwaters of the Nile and the end of navigation, we stopped at practically all the larger villages from Khartoum to Rejaf.



FIG. 53.—Our boat, *Lord Cromer*, on the Nile.



FIG. 54.—My working quarters on the *Lord Cromer*.

About two days' journey from Khartoum we saw our first hippo, and from that time on we saw hundreds, including many little fellows on the backs of their mothers. Crocodiles in great numbers, sunning themselves on the banks, could also be seen. From Bor to Rejaf we saw more than a hundred elephants. A big bull elephant whose tusks weighed 99 pounds was shot by one of the hunters near Bor. The Nile River is practically alive with fish of many varieties, the prize among which is the Nile perch, said to grow to a weight of 200 pounds. The perch are caught with live bait or by spooning, and



FIG. 55.—Roan antelope at Gemeiza.

furnish excellent food. Two of the strangest fish are the electric catfish and the lung fish.

The plant life of the Sudan is meager; except at Khartoum, where irrigation is practiced, few plants and flowers are found. Bird life, however, is most abundant along the Nile, possibly more abundant than in any other locality. I think it is no exaggeration to say that I saw millions of birds, among them weaver finches, bee-eaters, marabou and jabiru storks, kingfishers, various ibises, river eagles, white-faced tree-ducks, herons of many kinds, stone-curlews, horn-bills, shoe-bill and open-billed storks, egrets, various kinds of cranes and geese, and



FIG. 56.—Mr. Osgood Field with his first buffalo at Pariak.



FIG. 57.—Our guide at Pariak.

numerous others. It was my exceedingly rare privilege to see three shoe-bill storks in the wild state while passing through the Bahr-el-Zeraf.

One could not visit Africa without being convinced that the "ants" are of great importance there. Though called ants, they are really termites: the homes they build are sometimes 10 or 15 feet high and as many feet in width.

Because of the overflow of the Nile, during the spring season, the soil along its banks is very fertile, and native villages and farms are



FIG. 58.—Natives at Pariak.

almost continuous along the river. The principal crop is durra, a grain corresponding to our wheat.

The Shulukus, Dinkas, and Neurs are the three principal tribes living along the Nile between Khartoum and Rejaf. The men are tall of stature, but the women are short, though of very good build. In the morning they could be seen carrying jars or tin cans on their heads, coming to the river for the day's supply of water.

During a period of about 20 days we collected 270 specimens of bird and animal life, to say nothing of the 35 large trophies taken by the sportsmen. Material for a gazelle group was obtained, together with all necessary accessories, such as earth, ant-hills, thorn-bushes, and palms. Incidental collecting included turtle shells, fish, insects,



FIG. 59.—Dinka cattle village of Upper Nile.



FIG. 60.—An elephant shot by Mr. Marcus Daly near Bor.



FIG. 61.—Gazelles shot by Mr. Osgood Field. The mounted group is now on exhibition in the U. S. National Museum.

nests, shells, and woods. Fifteen thousand feet of moving picture film of native and wild animal life and 900 still pictures were taken. Among the interesting animals seen during the expedition were elephants to the number of over a hundred, lions, antelopes, water-bucks, kobs, monkeys, baboons, hippos, crocodiles, wart-hogs, buffaloes, gazelles, giraffes, zebras, reed-bucks, serval cats, and birds of many varieties, including the rare shoe-bill stork.

We were not permitted to go through the Bahr-el-Ghazal because of local trouble with the natives known as Neurs. This fact unfortunately excluded us from one of the best hunting grounds in the Sudan.

EXPLORATIONS FOR MOLLUSKS IN CUBA UNDER THE WALTER RATHBONE BACON TRAVELLING SCHOLARSHIP

BY PAUL BARTSCH,

Curator, Division of Mollusks, U. S. National Museum

The granting of the Walter Rathbone Bacon Travelling Scholarship for 1928-29 to me by the Smithsonian Institution made possible much-needed field investigations prior to the publication of reports upon the land and fresh water mollusk fauna of the West Indies. It was the desire of the late Mr. John B. Henderson, a Regent of the Smithsonian Institution, to prepare a report upon this fauna, to the study of which he devoted more than a quarter of a century of available time as well as considerable money for the financing of various expeditions, in many of which I had a part. Mr. Henderson's untimely death interrupted the project, and it has become my aim to see it carried out.

Under the Walter Rathbone Bacon Travelling Scholarship the least known parts of the West Indies will be subjected to a hasty reconnaissance. The island of Cuba was known to harbor a large number of molluscan treasures not contained in the collection of the U. S. National Museum, and it was therefore chosen for a first attack. On the War Department's huge topographic map of Cuba were marked the known collecting grounds and the blank hills from which no collections were at hand. Localities to be given attention were selected after a consideration of the geologic features; for the substrate, whether composed of limestone or serpentine, determines whether a visit will result in a rich harvest in the case of the former, or disappointment in the case of the latter.

The next step was to get in touch with Dr. Carlos de la Torre, President Emeritus of the University of Havana, and the foremost student of Cuban mollusks, who has agreed to join the author in making known the molluscan treasures of the "Pearl of the Antilles." We set out early in June for the western end of the island, subjecting first those parts of Pinar del Rio Province to such scrutiny as seemed desirable.

A word about the problems connected with our work may not be out of place here. The first consideration was the collecting of material to form the basis for a monograph. This included the securing



FIG. 62.—Ensenada Vinales, looking toward the Puerta del Ancon which is represented by the gap in the left of the background. The indentation to the right of this is the Cove of Delight.



FIG. 63.—A glimpse of the home of *Chondropoma hendersoni*, Costanera del Abra.

of specimens in type localities to decide the systematic status of previously described forms; the securing of new material to make the monograph under preparation as complete as possible; making descriptions in the field of the living animals, including color notes; and the collecting of anatomic material to help elucidate the relationship of the various groups. The collections thus obtained will enable us to give not only an account of the fauna, but also the range of the individual species, and this in turn will make an interesting contribution to the study of zoogeography.

Another important field of study was the intimate relationship, as well as the differentiation, presented by the mogote faunas. As an example of this may be mentioned the faunas of the Tertiary limestone mogotes south of the Organ Mountains which present a splendid basis for studies in heredity, a problem constantly borne in mind.

It was proposed also to trace these faunas to their probable origin in geologic times, and to see if the living material could be used as horizon markers for geologic formations. Collections were made of fresh water mollusks, some of which serve as intermediate hosts for parasitic worms of man and animals of economic importance, and the hydrogen ion conditions under which these exist were determined, in the hope that here, as in Japan at our suggestion, ways may be found for their control or eradication by a change of the hydrogen ion conditions in the water which they inhabit.

We chose the rainy season in spite of its discomforts, for it is at this time that land mollusks which have dug in deeply into nooks and crannies and rocky crevices, or under the rock slides of talus slopes, are tempted by the moist atmosphere to emerge from their estivation and take up life anew. It is at this time that the paredones are swarming with feeding and mating animals, while in the dry season little of molluscan life would be in evidence. Although collecting at this time entailed almost daily drenchings, the joy occasioned by obtaining choice living material in abundance causes one to forget the discomforts of soaked clothing.

Western Cuba is beautiful. Its dissected limestone mountains with their tropical flora are ever picturesque. Even now as I write, rock rimmed hoyos or ensenadas teeming with molluscan riches rise before me, and I seem to hear the song of the Cuban solitaire filtering down from the higher reaches to convert the whole into an enchanting scene, for be it remembered that the solitaire challenges the efforts of the nightingale.



FIG. 64.—Puerta del Ancon, a favorite collecting ground in Pinar del Rio Province.



FIG. 65.—Along the highway between Havana and Matanzas. Dr. de la Torre and Mrs. Bartsch looking for the tree snails *Liguus*, which are abundant in the flamboyant trees bordering the road.

The use of automobiles, small tents, cots, and alcohol cooking stove simplified our transportation, housing, and food problems. In Pinar del Rio Province we made headquarters at Taburete, San Diego Banos, Pinar del Rio, Vinales, Banos San Vicente, and Luis Lazo, from which centers we radiated in all directions. Where the automobile was unable to carry us, we traveled on horseback or on foot.

In the western end of the island we have a lowland coastal plain fauna, consisting of a restricted number of species of rather wide distribution, which follow the shore lines where they occupy every suitable location. Then we have an equally widely distributed scattered fauna of the grass lands and cultivated plains best represented in the hedge rows and fence corners which are less disturbed by the machete and the plow. By far the greater in number and the most interesting is the calciphil fauna which is restricted to the limestone outcrops of the mountains and hills. Here one finds the Urocoptids, sometimes hundreds in the space of a square yard, fixed by their aperture with a dried mucous film to the sun-exposed, apparently barren face of the limestone cliffs. In the little more shaded portions of the same block, a number of species of Helicinids and Annulariids are sure to be found, while scratching among the talus débris at the base of the cliff will yield *Pleurodonte*, *Microceramus*, *Oleacina*, *Cepolis*, *Megalomastoma*, *Subulina*, and *Geomelania*. Where brush and timber cover these hills, *Liguus*, the large, brilliantly colored tree snail, may be seen fixed to the trunks or branches like some showy flower.

It was most interesting to observe the extreme isolation and limited range of some of these forms; for example, *Chondropoma hendersoni* Torre, the showiest of the Annulariids, is restricted to the upper summit portion of the Costanera del Abra. All the specimens so far collected have been a few living individuals that probably had ventured to climb up on some exposed plant or rock, from which a sudden gust of wind or some other agency may have dislodged them and started them on their downward course which eventually placed them within the reach of the collector. We secured only three living specimens, but gathered a number of dead shells on the talus slope at the base of the unscalable paredones. Even these dead shells are to be found only at the base of the cliff, in a space about the length of a city square, and this in spite of the fact that the bold face of the mountain extends for several miles.

Contrasting with this is *Chondropoma sagebieni* Poey, which we find on the exposed limestone bluffs ranging from Mendoza east to San Diego Banos. This species and its associates tell a wonderful



FIG. 66.—An undisturbed group of *Cerion infandum* at Punta Sabanilla, Matanzas Province.



FIG. 67.—A glimpse of the Yumeri Valley, Matanzas Province.

story. They are true Calciphils, that is, lovers of limestone, and are restricted and dependent upon exposed limestone surfaces. They are absolutely unable to exist in the meadows or grasslands, and yet we find them in every suitable habitat of all the Tertiary mogotes scattered throughout the range mentioned above. Their distribution must date back to the days following the Oligocene uplift when they were able to travel over an unbroken surface throughout their present range. Since then the tooth of time has been busily engaged in returning to the sea her treasures, and wherever you look, you see the process in action. There are still extensive areas of rugged blocks with bold escarpments in places, while in others the paredones have been reduced to the size of a door, but by far the greater area has yielded completely to the force of erosion.

Wherever there is still a bit of limestone showing, there one may find *Chondropoma sagebieni* and its associates, usually sufficiently modified by their long isolation and inbreeding to present certain fixed characters that will enable the careful student to recognize these isolated colonials, even when removed from their home. To the student of genetics, Western Cuba presents a wonderful and gigantic laboratory in which nature has been conducting her experiments in heredity on a lavish scale.

Havana Province for the greater part is low and under cultivation, but the Jaruco Mountain complex in the northeastern portion of the province, Sitio Bonilla and Sitio Perdido, present a veritable labyrinth of limestone blocks and strings of blocks and paredones. Here we found the differentiation of Urocoptids simply marvelous, the shells varying from short to long, thick to thin, and smooth to ribbed and hollow ribbed, and it will be years before the last subspecies will have been made known from this region.

In Matanzas Province we made the city of Matanzas our headquarters. We covered the northern part by automobile, penetrating as far east as Cardenas and southeast to Banos de los San Miguel. Two things are outstanding in our memory—the visits to Fundador and to the Yumeri Valley. Fundador may be called the “Cradle of Cuban Malacology,” for it was here that Dr. Louis Pfeiffer, Dr. Juan Gundlach and Dr. Otto, three enthusiastic young German naturalists, came in 1839, Pfeiffer with the intention of making an exhaustive study of the Cuban mollusks in three months; Gundlach to get acclimated before going to Surinam; and Otto, looking for medicinal plants.

These men collected a large amount of material about Fundador and the adjacent region which was described by Pfeiffer. Gundlach fell

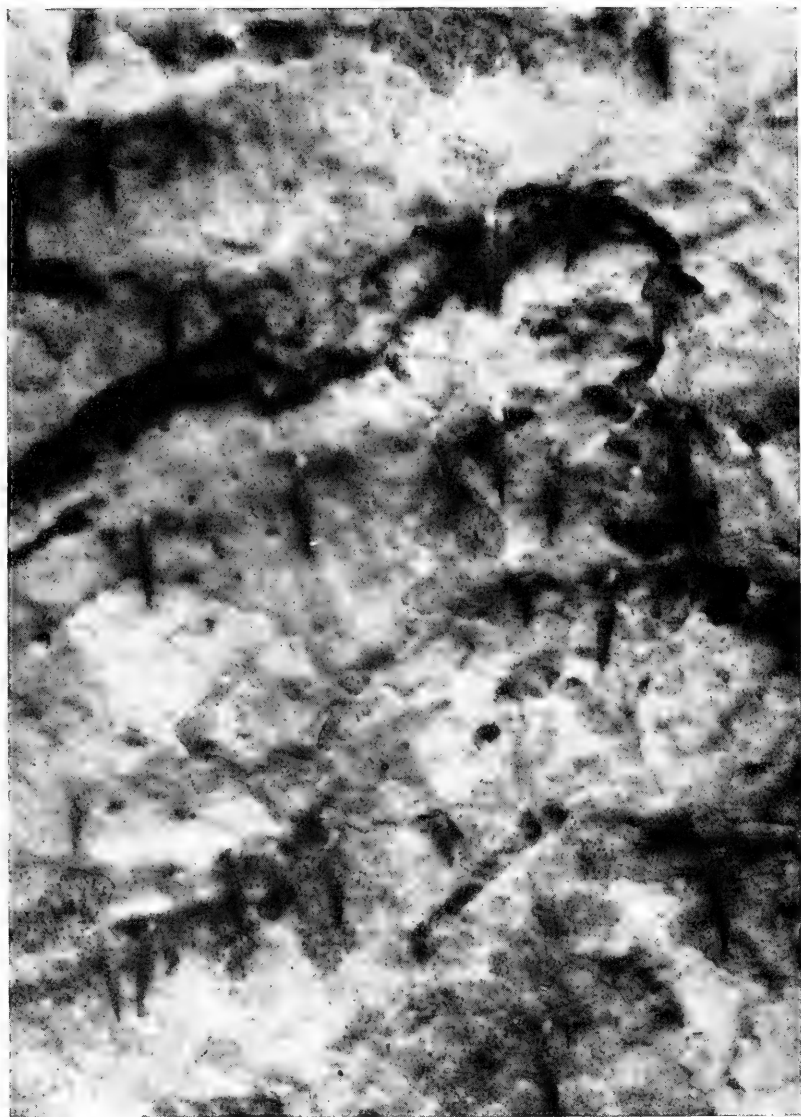


FIG. 68.—Portion of a colony of Urocoptids, showing their abundance and method of occurrence at Vista Alegre, Matanzas Province.

in love with the island and, instead of continuing his journey westward, remained here for the rest of his days excepting a short stay in Porto Rico during one of Cuba's political upheavals. Gundlach is in reality the father of Cuban natural history, for through his efforts probably more organisms of the island were made known than through those of all the other naturalists taken together. The visit to Fundador therefore was in reality a pilgrimage to an historic shrine. The old walls are still standing, but the picturesque palm thatched roof has given way to the ever-evident American corrugated iron. The fields once teeming with coffee plantations are now only grazing grounds, but the old Ceiba tree beneath whose shade our naturalists must have foregathered, was still standing in the foreground, while through the feathery tops of royal palms Pan Palenque and Pan Matanzas rear their towering blue masses in the distance above the plain, and beckon as they did in the days of long ago. We secured topotypes of all Pfeiffer's species but one.

Yumeri Valley, designated by Baron von Humboldt as the most beautiful in the world, was next subjected to a close scrutiny. The rim of limestone mountains encompassing this valley harbors an exceedingly rich molluscan fauna. Of particular interest were the inhabitants of the small mogotes, the blocks of limestone frequently separated only by a stone's throw from the main ridge, and yet containing a faunula distinct from the parent range. One of these small blocks not larger than an ordinary house, harbors the exquisite *Chondropoma presasiana*.

In Santa Clara Province we worked westward from Sagua La Grande to Coralillo along the north coast, and east to El Purio near Calabazar. From Remedio we worked the hills all about, south to Zuluete and Los Sierras, and north to Caibarien and along the coast range from Caibarien to the Sierra de Jatibonico.

After excursions from Vega Alta as far north as Calabazar and south to Trinidad, our party set out for Camaguay Province. From Punta Alegre we secured passage on a little sailing schooner for Turigano Island. This was a marvelous cruise, threading our way through intricate channels among the numerous mangrove islands and endless mud flats teeming with flocks of gorgeous flamingoes, a number of species of herons and terns, as well as ibises and cormorants.

At Turigano the staff of the American Company that has placed the island under plantain cultivation assisted in every way to make our stay a success. Here we discovered a brilliantly orange-colored *Liguus* which is most likely the ancestor of the orange element in the

Florida tree snail. From Turigano we proceeded to Moron and then to Cunagua, and we next made our headquarters at Central Jaronu on the north side of the Cubitas Mountains. Here we were greatly assisted by the officials of the Central who placed gasoline motor cars and horses at our disposal. From here we were able to explore Paso Tinaja, Paso Escalera, and Paso Lesca.

The last point of vantage was at Central Senado on the south side of the Cubitas Mountains. Here we reached the high-water mark of our endeavors. With the aid of gasoline cars, automobiles,



FIG. 69.—A glimpse of the bluffs bordering the Canimar River at Fundador, a type locality of Pfeiffer.

horses, and an able guide placed at our disposal by Sr. Jorge B. Sanchez, we explored Loma Sta. Cruz, Caridad de Mendoza, and Los Corrales de Cangilones, as well as the paredones bordering Paso Vereda de Burro, Paso Guanaja, and Paso Paredones, in each of which were made a number of stations. These passes cut through the east end of the Cubitas Mountains and separate them into a series of limestone blocks. The walls rising to a height of several hundred feet are covered with ferns and palms and other tropical vegetation that would delight a botanist's heart, while the birds would fascinate an ornithologist, and nowhere in our entire Cuban experience did we find molluscan life as abundant as here.



FIG. 70.—A glimpse of the beautiful Bay at Punta Alegre, Camaguay Province, a favorite collecting ground of Gundlach.



FIG. 71.—A glimpse of the canal between Laguna de Leche and Moron, Camaguay Province. The bird on the bow of the boat is the Cuban sandhill crane.

In closing this account, I wish to express my thanks first of all to the Smithsonian Institution for granting the Fellowship, which has yielded more than 250,000 specimens to the U. S. National Museum; to Dr. Carlos de la Torre and through him to all the Cuban Governmental Agencies whose endorsements opened the gates to us wherever we went; to our Embassy and Consular office in Havana; to the officials of the University of Havana for assigning to us a laboratory



FIG. 71A.—Dr. Juan Gundlach, the father of Cuban natural history.

at the Poey Museum; to Professor Guillermo Aguayo, Dr. Pedro Bermudez, and Sr. Emilio Portuondo; to Mrs. Bartsch, whose presence and ever-ready help during our western campaign made this a most delightful experience; to Mr. H. N. Lowe, of Los Angeles, California; and to Mr. Ray Greenfield, a Boy Scout of Washington, who proved of great assistance throughout the entire campaign. Thanks are also extended to the many men throughout the island who, with true Cuban hospitality, lent a helping hand whenever possible to make our work a success.

THE CERION BREEDING EXPERIMENTS AT THE TORTUGAS

By PAUL BARTSCH,

Curator, Division of Mollusks, U. S. National Museum

For the past 16 years I have conducted experiments in heredity through the cross-breeding of mollusks of the genus *Cerion* at the Marine Biological Laboratory of the Carnegie Institution at the Tortugas, Florida. My visit to the station this year was a short one; I arrived on August 17, 1928, and left with the Dohrn on the closing of the laboratory August 20. However, sufficient time was granted me in this period to make the examination of the *Cerion* colonies. A careful examination of the contents of the little artificial islands, on each of which a specimen of two species are segregated for possible cross-breeding, showed the presence of some young individuals, but no adult hybrids.

An examination of the cut-down cages, however, revealed one adult of the much looked-for cross between *Cerion viaregis* and *C. incanum*. It will be remembered that considerable criticism was expressed because, in my original crossing experiments, I had employed large groups (500 individuals) of each of the two species, and doubt was expressed as to whether the organisms which I claimed to be crosses were really crosses. Some of my critics held that they might be mutations of one of the two species involved. To settle this, the individual cage and island method was resorted to. These restricted areas were stocked with a virgin individual of each of the two species mentioned above. The results were what I expected, a perfect vindication of the mass experiment, for the adult hybrid obtained in the cage is in every way identical with those secured from the mass experiment on New Found Harbor Key. This of course was to be expected, for in no colony of *C. viaregis* or *C. incanum* has any form appeared comparable in appearance to the hybrids in question. Thousands upon thousands of specimens were examined in all these colonies, and never once has an individual turned up which might have given one the slightest doubt as to the specific identity of the individual in question.

While at the Tortugas I had sufficient time to spend part of a day under water with the diving hood and the undersea camera, going over the fields photographed in the years gone by, in order to have a continuous record of what is happening on the reefs impressed upon photographic film.

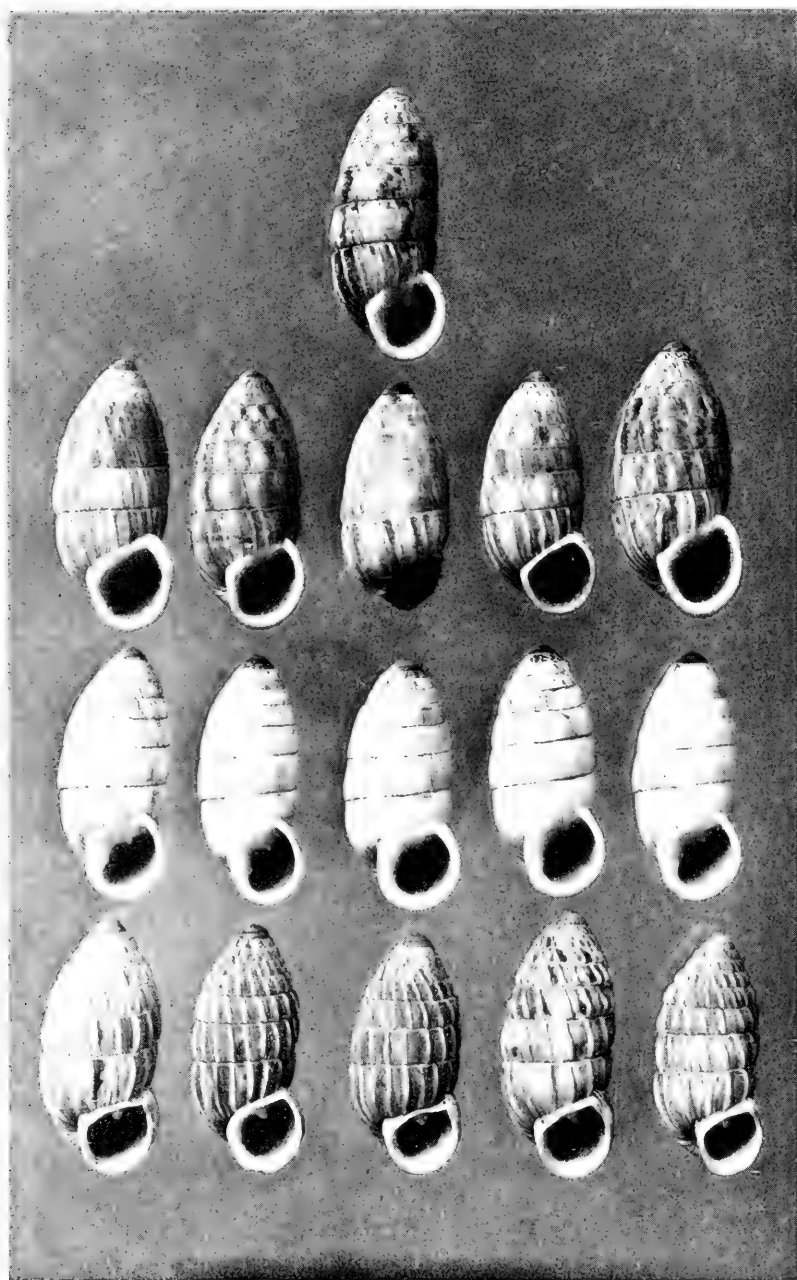


FIG. 72.—Top figure: the hybrid *Cerion* from Loggerhead Key. Second row: the hybrid *Cerion* from Newfound Harbor Key. Third row: *Cerion incanum*. Fourth row: *Cerion viaregis*, the last two being the parents of the above.

THE CRUSTACEA OF BEAUFORT, NORTH CAROLINA

By WALDO L. SCHMITT,

Curator, Division of Marine Invertebrates, U. S. National Museum

AND

CLARENCE R. SHOEMAKER,

Assistant Curator of the Division

One rare American species of crustacea (*Callichirus major* Say) is known only through an incomplete specimen in the National Museum and two "arms" in the British Museum of Natural History. The Washington specimen came to the Museum from Beaufort, North Carolina, and in an effort to add to the information regarding it, and also to study the other crustacea of the region including the wholly undescribed amphipods, we undertook a short trip in September, 1928, to the U. S. Bureau of Fisheries Laboratory at Beaufort, in company with Mr. Boon C. Indrambarya of Siam, who was at that time studying the Museum's crustacean collections.

The type locality of *Callichirus major* was given by Say as "the bay shore of the river St. John in East Florida," and it was said by him to be common along the coast of the Southern States. Unfortunately, however, a thorough search at Beaufort failed to reveal any specimens of this greatly desired species. We were able though to dig out a number of *Upogebia affinis* Say, a related form, and to observe the nature of the flats occupied by them, and to trace at least one burrow more or less completely. Two specimens were found in this burrow, the lower of these being found in the blind end of a more or less perpendicular diverticulum of the tunnel system, about 18 inches below the surface. Otherwise the greater part of the burrow, which was apparently not very extensive, seemed to lie in a plane about five inches below the surface. One upper terminus was dug out and saved. As the tunnel approached this opening at the surface it became constricted, in a space of about two inches, from a usual diameter throughout of about $\frac{5}{8}$ of an inch to one of about $\frac{3}{16}$ of an inch at the point of egress. This remarkably narrow opening Dr. Schmitt has found also in the burrow of another species of the same genus. In view of the consistency of the compacted sandy mud, the burrow must have been begun while the animals were yet small, and then enlarged from within as the occupants grew. The original point of ingress, or the opening placing the tunnel system in communication with the outer world, is not large enough to permit the



FIG. 73.—A few of the myriads of fiddler crabs that inhabit the mud flats about Beaufort. (Photograph by Indrambarya.)



FIG. 74.—Oyster reef at Gallant Point. (Photograph by Indrambarya.)



FIG. 75.—The U. S. Bureau of Fisheries Station on Piver's Island, as seen from the town of Beaufort. (Photograph by Shoemaker.)



FIG. 76.—A section of the Beaufort waterfront. (Photograph by Shoemaker.)

passage of the full grown animals found in the burrows. Apparently they spend a considerable portion, if not all, of their lives wholly within the one and original burrow. When excavated animals are released on the mud flats, they enter the first worm or clam hole encountered and dig in at once.

In four days' work at the station, some 1,300 specimens of marine invertebrates were secured for the national collections. The bulk of those collections consisted of amphipods, a group of the local fauna which is wholly unworked. The earlier naturalists who collected at



FIG. 77.—Searching for burrowing crustacea, Gallant Point.
(Photograph by Shoemaker.)

Fort Macon and vicinity appear never to have studied their amphipods, while the later ones seem even to have neglected collecting them. It is planned to use this material as a nucleus for a report on the Amphipoda of Beaufort and vicinity, though a great deal more collecting for amphipods needs yet to be done before the region can be said to have been covered for these forms with any degree of completeness. The present collections are only from the shallow water.

We wish to express our appreciation to the U. S. Bureau of Fisheries for accommodations and facilities so generously provided at the station, and in particular to Dr. S. F. Hildebrand, the director, for his personal interest and assistance in our work.

FURTHER OBSERVATIONS ON THE NATURAL HISTORY OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE

BY JAMES O. MALONEY,

Aid, Division of Marine Invertebrates, U. S. National Museum

With the object of carrying forward the natural history investigations begun the previous year by Mr. and Mrs. Paul Bowman, under the joint auspices of Mr. Copley Amory and the Smithsonian Institution, the writer was enabled through a continuance of Mr. Amory's kind offices to spend three and one-half weeks, beginning July 13, 1928, at Matamek River, Province of Quebec, Canada, studying and collecting the invertebrate fauna of the region, with especial reference to the crustacea.

As dredging facilities were not available this season, collections of the marine forms particularly desired were confined largely to the intertidal zone, and to an examination of the stomach contents and intestines of fish taken by hook, net, and trap. Collecting for terrestrial forms of invertebrates and the examination of fresh-water ponds and streams were also undertaken. From these several sources over 1,200 specimens were secured, including marine invertebrates, chiefly crustacea, echinoderms, and mollusks, as well as parasitic worms, fishes, and insects.

A striking feature of the coast line along the Matamek shores is the extreme smoothness of the rocks, caused by the grating of the ice during the long winters. As a result very few barnacles were found and then only in sheltered places. Likewise the algal growth was very scanty, probably accounting for the scarcity of crustaceans, other than amphipods. The latter were to be found everywhere and in great numbers, both in point of species and individuals. They form the chief crustacean element in the marine fauna of the region. No terrestrial or fresh-water crustacea were observed.

In the course of my return to Washington, the first week of August was spent at Seven Islands, a small village some 30 miles south of Matamek River, where limited collections were made. The fauna is virtually identical with that existing in the Matamek region. Laboratory studies on the material collected in both regions are now in progress.



FIG. 78.—The “factory” on Mr. Copley Amory’s estate on Matamek River. This building functions as a boat house below, while on the upper floor is the working laboratory and storage for boat-dredges and fishing gear.



FIG. 79.—The “residence” and outbuildings at Matamek River. The laboratory is but a few steps to the right of this group of buildings.



FIG. 80.—Coast line at Matamek River, showing nature of intertidal zone.

BRINGING TO AMERICA THE BAKER COLLECTION OF MALAYAN INSECTS

BY R. A. CUSHMAN,

Assistant Custodian of Hymenoptera, U. S. National Museum

One of the greatest collectors of insects of all time died at Manila, P. I., on July 22, 1927. He was Charles Fuller Baker, dean of the College of Agriculture of the University of the Philippines. By his will all of his entomological collections, which he had accumulated during a residence of 15 years in the Oriental Tropics, principally in the Philippines, and the correspondence and other papers relating thereto were left to the U. S. National Museum on condition that the Museum send someone to Los Baños to attend to the packing and shipping. Having been assigned this duty I left Washington on October 3, 1927, armed with pinning forceps and paraffine paper and what I fatuously expected to be an adequate supply of insect pins and fumigating chemicals. At Seattle I purchased five bales (about 800 lbs.) of excelsior, which I also fatuously expected to be sufficient.

On October 11 I sailed from Seattle on the American Mail Liner President Jefferson. For the first week Neptune was unkind and many of the passengers, including myself, were correspondingly uncomfortable, but thereafter we enjoyed a very pleasant voyage. Among the passengers was Dr. Joseph F. Rock, the famous botanist-explorer, who, accompanied by two of his "boys," was embarking on another trip into the wild mountainous country of Western China. My acquaintance with him was most pleasant and profitable. We arrived at Yokohama two days late because of the storms encountered, and so had a very limited stay. From here I took the opportunity of visiting Tokio, where I had a delightful two hour stroll about the streets and parks with Dr. S. I. Kuwana, the famous Japanese entomologist. After stops at Kobe, Shanghai (where Dr. Rock left us), and Hong Kong we reached Manila on November 3.

At the gang plank I was met by Dr. Robert L. Pendleton, administrator of the Baker estate and professor of soils at the College of Agriculture. From that moment until I left Manila for home Dr. Pendleton let no opportunity pass to assist me in my task and its attendant problems or to make my stay in the Islands comfortable, enjoyable, and profitable. After the formalities of the customs, dis-



FIG. 81.—Charles Fuller Baker, whose great collection of Malayan insects is the subject of this article, as he appeared shortly before his death. (Photograph by Sun Studio, Manila, P. I.)



FIG. 82.—*A*, Dr. Robert L. Pendleton, administrator of the Baker estate. *B*, The Pendleton home—and mine during my stay in the Philippines. *C*, Fidel, Ney San, and Kurajigui. *D*, Mt. Maquiling, a collecting ground made famous by Baker. *E*, Kurajigui. *F*, A royal palm-lined avenue on the campus of the College of Agriculture, with the Administration Building in the distance.

posal of baggage, etc., we drove the forty-odd miles to Los Baños, and inspected the Baker house and collection, and by early afternoon I was installed as a member of the household of Dr. Pendleton.

During the long interval between the death of Dean Baker and my arrival at Los Baños, Dr. Pendleton had daily visited the home of Baker, where the collection was housed, and had made frequent inspections of the walls, floors and partitions for termite injury. In addition he kept in the service of the Baker estate two of Baker's employees, Kurajigui, a Japanese handyman, and Fidel Agoba, a Filipino collector. Under his orders these two faithful retainers had maintained watchful guard over the house day and night, keeping brazier fires during rainy and cloudy weather, replacing weakened timbers when necessary, and in every way preserving the premises and the collection in good condition against the arrival of the representative of the National Museum to take over the responsibility.

Baker's house was a modification of the native house with swali (split bamboo matting) walls and corrugated iron roof instead of the nipa thatch still commonly used by the natives. It stood on stilts about eight feet above the ground, and was floored partly with split bamboo lath. The windows were of a marine shell used almost universally in the better homes instead of glass, and the ceilings were of a finer weave of swali. It was about 24 by 30 feet with a swali partition down the middle and two cross partitions, dividing it into one room occupying one-half of the floor space and three small rooms in the other half, each of these small rooms opening into the main room or sala but not connected with each other. His growing collection, library, and card files had gradually encroached on the domestic arrangements of his house until at the end these were limited to a rickety bamboo bed at one end of the sala and an old-fashioned washstand in a corner of one of the small rooms. At the rear was a bamboo porch partly occupied by a storeroom for packing material, alcohol, kerosene, etc. From one end of the porch an elevated passageway led diagonally to a small house where lived Kurajigui and his wife, Ney San, and where Baker ate the meals prepared for him by Ney San.

In these surroundings, far less comfortable than those of many of the natives who worked and studied under him at the college, and much of the time in very bad health, Baker brought together the greatest collection of Malayan insects ever assembled, occupying well over 1,400 Schmitt boxes, collections of shells and fungi, and a catalogue of Homoptera estimated to comprise 100,000 cards all written by his own hand. In addition to this he carried on a correspondence



FIG. 83.—Baker's home and workshop. Left to right are Kurajigui, Ney San, and Fidel.



FIG. 84.—Baker's next door neighbor. In the picture are bananas, cocoanut and areca palms, bamboos, and many other plants.

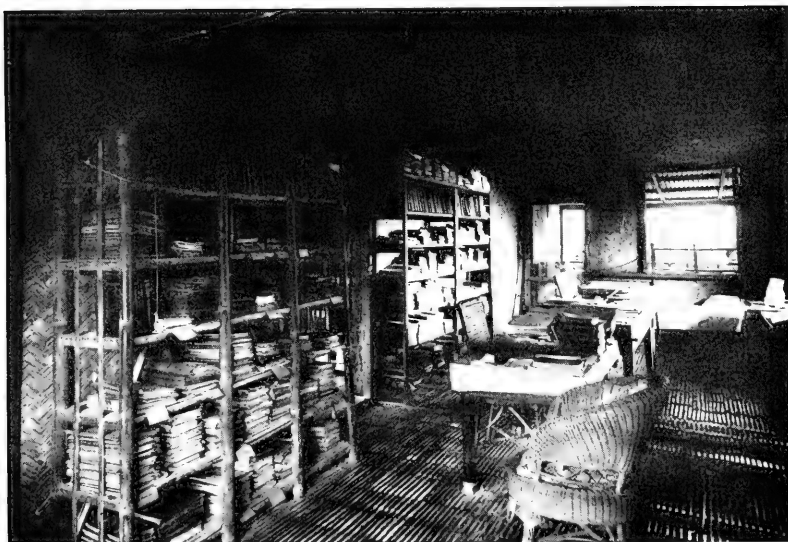


FIG. 85.—The main room or sala in Baker's house. Note the bamboo lath floor. The walls, ceiling, bed, and bookcase are also of bamboo. (Photograph by R. L. Pendleton.)

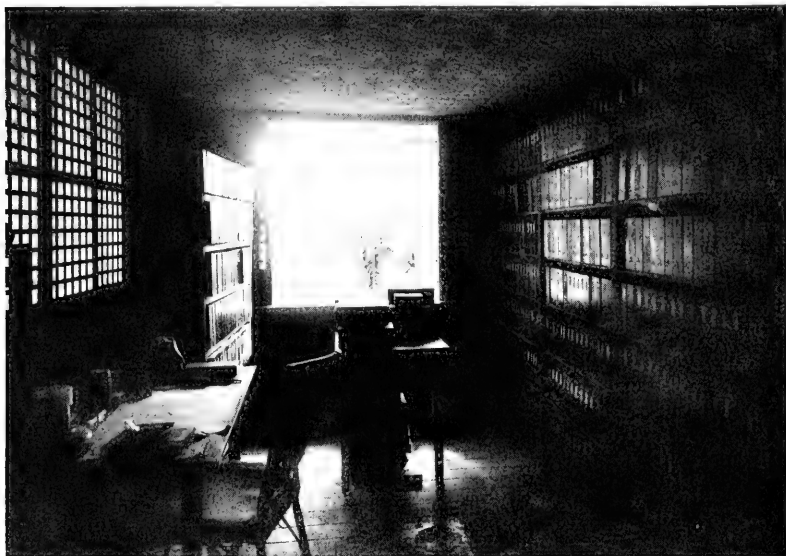


FIG. 86.—The room where Baker did his entomological work, showing part of the insect boxes. Two other rooms contained even more boxes. Note the shell window at left. (Photograph by R. L. Pendleton.)

with and sent specimens for identification to specialists all over the world, writing all of his letters by hand. All of this work was carried on in time outside of his official duties at the college and many other activities in which he took part.

On the morning after my arrival at Los Baños the work of preparing the collection for packing began. A brief general examination showed that every pin (about 300,000) would have to be set more deeply in the cork lining of the boxes, and that some specimens, comparatively few in percentage of the whole but in the aggregate a considerable number, would have to be cleaned of mold and verdigris. Kurajigui and Fidel soon acquired the requisite skill in handling the forceps and in cleaning the specimens but it required practically a month for the three of us to finish this portion of the work, which also involved the use of many thousands of extra pins for bracing large specimens and such as were loose on the pins. Fidel, who had been suffering from some eye trouble, had stuck to the task up to this time, but had to give up here and Kurajigui and I finished the job.

In the meantime I placed an order for the requisite number of packing cases with the Insular Lumber Company. These were sold to me at such a price that the cost of manufacture amounted to a gift to the project, and this was but one instance of the attitude displayed toward the matter by nearly everyone with whom I had dealings.

The next three operations in the preparation of the Schmitt boxes for packing were carried on concurrently. In order to prevent so far as possible the formation of mold, which in the tropics is controlled only with great difficulty, each box was opened to the full sunlight for about 10 minutes. Before being closed it was given a dose of a saturated solution of paradichlorobenzene and naphthalene in carbon tetrachloride, closed immediately and, while still hot, wrapped in heavy paraffine paper sealed with a hot flatiron. These operations could be carried on only for four or five hours during the heat of the day, and were further slowed up by the many cloudy days that intervened.

Time unsuitable for sunning boxes was devoted to the nailing together of the packing cases, which had been delivered in the form of "shooks," and providing them with rope handles. I nearly lost caste in the eyes of the natives because I worked on this job with Kurajigui instead of letting him do it alone.

When the sunning and wrapping of the insect boxes was finished they were tied into bundles of five and wrapped in another sheet of paraffine paper. Three of these bundles were tied together with heavy sea island cotton cord and packed in a case with about 20 pounds of excelsior. After packing the first few boxes I suddenly realized with

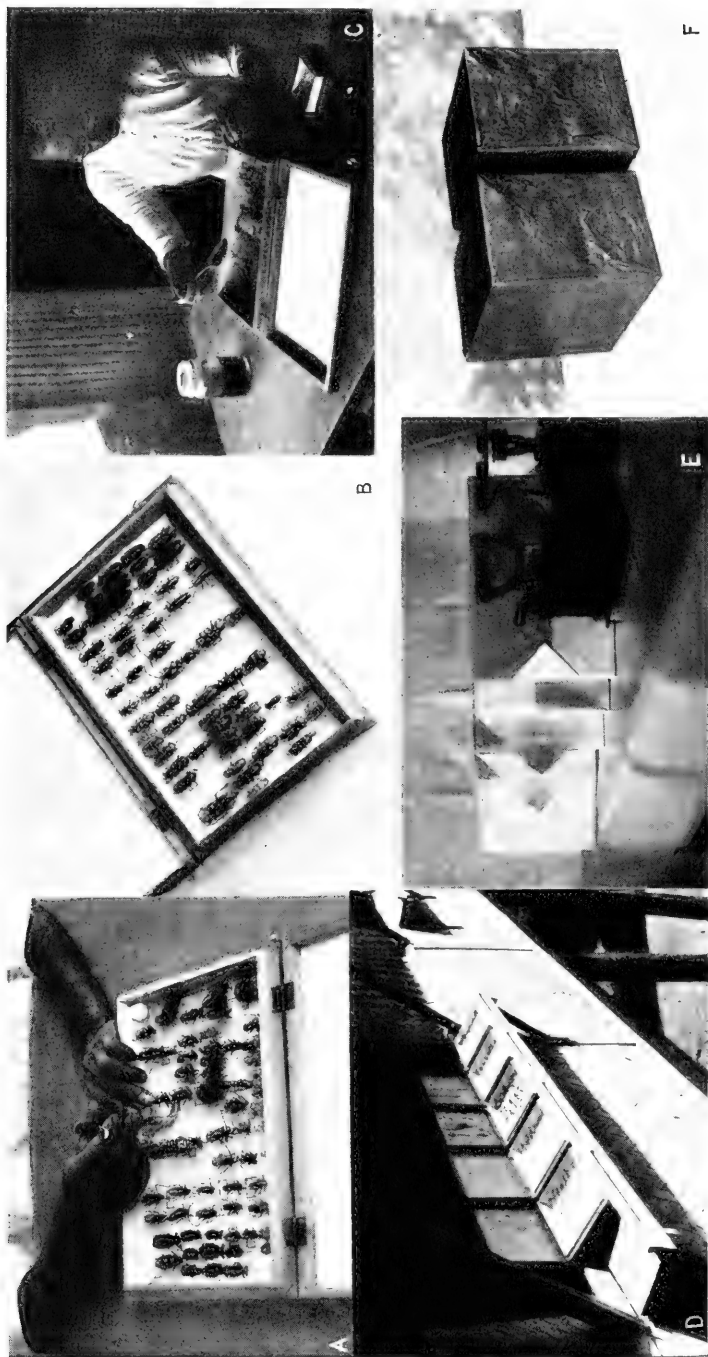


FIG. 87.—*A*, Setting the pins. The hands are Kurajigui's. *B*, Ready for the sun bath. This box required 122 brace pins. *C*, Kurajigui administering the "medicine." *D*, Boxes on the sunning rack. *E*, Steps in the wrapping and sealing and the equipment used. *F*, Two packages of five boxes each.

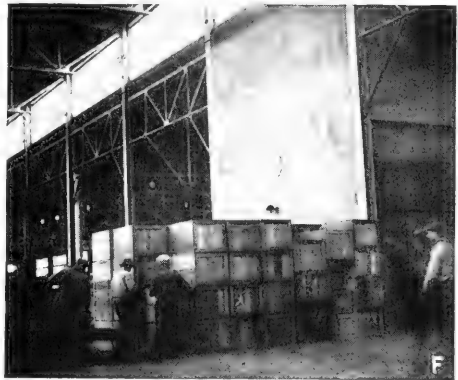
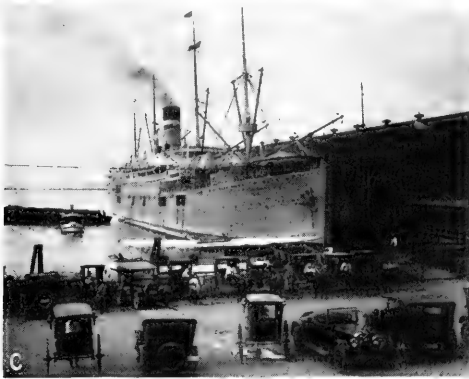


FIG. 88.—*A*, The packed cases. *B*, Barge bearing Baker collection leaving pier at Los Baños. *C*, The U. S. A. Transport *Thomas* at her dock in Manila. The barge being towed alongside. *D*, Loading cases into hold of the *Thomas*. *E*, Unloading from the *Cambrai* at New York. *F*, The cases stacked on the pier at New York.

consternation that the supply of excelsior that I had so thoughtfully and with such trouble provided (it caused me more difficulties than anything else), was woefully inadequate. Fortunately, however, through the kindness of Major Damman, I was able to supply my needs at cost, at the Quartermaster's Depot at Manila.

On January 18, the last nail was driven, almost ceremoniously, into the one hundred and fifth case and the packing was finished. The problem of getting the bulky shipment to Manila was solved by Major Clarence Tingle, Superintendent of the Transport Service, who offered to send an army barge and tug to Los Baños. The manager of the bottling works of Isuan Incorporated at Los Baños, provided material and men for the job of putting strapiron around the cases.

By previous arrangement the barge appeared at Los Baños on February 9, two trucks delivered the cases at the landing, where the strapiron was applied, and the collection started on its long journey to Washington. Under the watchful eyes of the first officer and myself it was stowed in the hold of the *Thomas* on the 14th, and on the 15th the ship sailed on probably her last trip across the Pacific.

Thirty-two days later, after calls at Ching-wan-tao, China, and Nagasaki, Japan, and after a very comfortable voyage, the *Thomas* docked at San Francisco. After overseeing the transfer of the shipment from the *Thomas* to the transport *Cambrai*, which brought it around through the Panama Canal to New York, I returned to Washington by rail. On April 7 I met the *Cambrai* at New York, where on the 10th, through the cooperation of the Coordinator's office and officers of the Quartermaster Corps, the collection was transferred from the ship to a freight car standing on the pier. Two days later the car reached Washington and the collection was transferred by truck to the Museum. Due very largely to the careful handling and considerate cooperation of the officers of the Quartermaster Corps, the collection reached the Museum without injury worth mentioning, to form one of the most valuable single accessions to the insect collection.

In conclusion I wish to extend my personal thanks to the Quartermaster Corps for all the courtesies and favors which rendered my labors most easy of accomplishment; to the College of Agriculture at Los Baños, especially to Acting Dean Gonzales, whose cooperation aided materially in lightening my task; to the business houses whose cooperation and personal interest in my project went far toward making it a success; and especially to Dr. and Mrs. Robert L. Pendleton for their many and continued kindnesses and their friendship.

THE BUTTERFLIES OF THE DISTRICT OF COLUMBIA

By AUSTIN H. CLARK,

Curator, Division of Echinoderms, U. S. National Museum

One hundred and nine years have passed since Mr. David Baillie Warden published in Paris a short list of the butterflies of the District of Columbia, and during that time only scattered notices of a few species have appeared.

With the transformation of the District from a region largely of woods and open fields to an area of city blocks and suburban dwellings and estates there has come a change in the local fauna. Some species, found especially in scrubby pastures, have almost disappeared, while others, living chiefly on common weeds thriving in unkept city lots and suburban gardens, are increasing in numbers. Others have disappeared through inability to meet the competition of new comers.

In order to construct a picture of the butterfly fauna as it exists at the present time extensive field investigations have been carried out in the District and vicinity. These investigations had to do especially with the local characteristics of the butterflies, the varieties of each found in this area, their local occurrence, and their habits.

Eighty-seven kinds of butterflies are now known from the District and its more or less immediate vicinity. But of these only a few are really common and many are very local, found only in widely separated places. Some are only accidental visitors. One, the cloudless sulphur (*Catopsilia sennæ*), which is not so very rare, is represented only by adventurous males which stray here in late summer. No females ever have been seen in this locality.

Two of our common summer butterflies, the milkweed butterfly (*Danaus menippe*) and the painted lady (*Cynthia cardui*), seem unable to survive our winter. Each spring wandering females enter the region and lay their eggs on their respective food plants in the low ground near the river. The young from these, appearing in July, scatter everywhere, and the next generation, in late August and September, usually is abundant. When the cool weather comes the butterflies hide away in some safe retreat in which they die.

Two other butterflies, the buckeye (*Junonia cæna*) and the red admiral (*Cynthia atalanta*), in the local bogs wherever their food plants grow, produce a large and richly colored form of more or less



FIG. 89.—*A*, Hop merchant (*Polygonia comma*), light or dry form (*harrisii*); October 6, 1928. *B*, Hop merchant (*Polygonia comma*), dark or wet form (*dryas*); September 8, 1926. *C*, Monarch, storm fritillary or milkweed butterfly (*Danaus plexippus*), female; October 13, 1928. *D*, Painted lady (*Cynthia cardui*), wet form; June 25, 1926. *E*, American painted lady (*Cynthia virginiensis*); September 11, 1926.

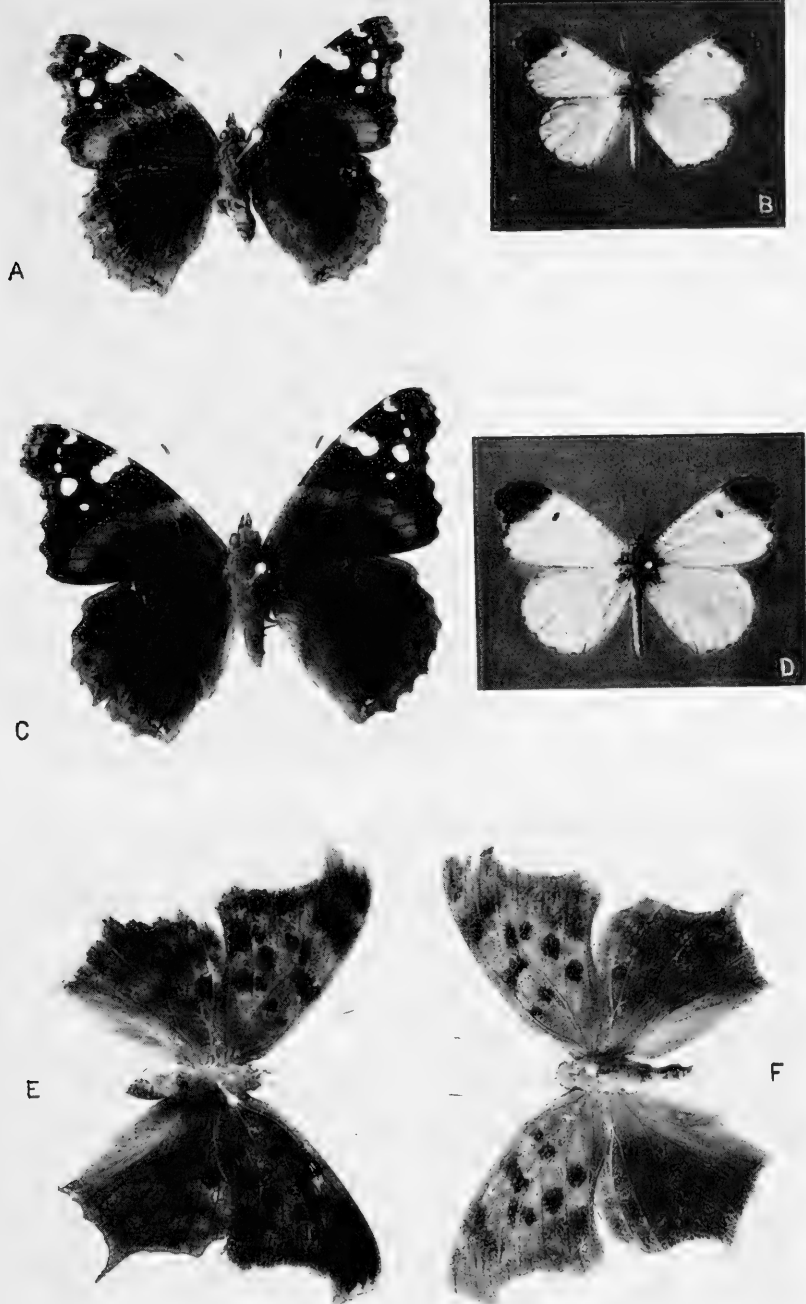


FIG. 90.—*A*, Red admiral (*Cynthia atalanta*), dry form; June 13, 1926. *C*, Red admiral (*Cynthia atalanta*), wet form; August 27, 1926. *E*, Question mark (*Polygonia interrogationis*), light or dry form (*fabricii*); September 11, 1926. *F*, Question mark (*Polygonia interrogationis*), dark or wet form (*umbrosa*); August 7, 1926. *B*, Orange tip (*Anthocharis midca*), male, small early spring form; April 13, 1925. *D*, Orange tip (*Anthocharis midca*), male, large late spring form; May 2, 1926.

lazy disposition which corresponds to the wet season form of related butterflies in India.

These large and handsome individuals, often very common in late summer in the restricted areas wherein they live, die during the winter, so that in the spring only the smaller and duller individuals corresponding to the Indian dry season form appear. These scatter



FIG. 91.—A, Buckeye (*Junonia cana*), female, wet form; September 27, 1925. B, Buckeye (*Junonia cana*), female, wet form; September 27, 1925. C, Buckeye (*Junonia cana*), female, dry form; August 1, 1927. D, Buckeye (*Junonia cana*), male, dry form; September 19, 1925.

widely, laying their eggs on the food plants everywhere. From eggs laid on certain plants in bogs a new generation of the large and handsome individuals arises which, like those of the preceding year, die leaving no descendants.

Wholesale waste of the life of individuals is nature's form of life insurance in regard to the species as a whole. With us these butterflies each year produce a strongly marked wet season form which in the

winter is killed out apparently through dessication in the cold dry winter air. Should our climate undergo a change and should we have alternate seasons dry and wet as occur in India instead of a cold winter with severe dry spells and a summer dry in some localities and wet in others, our butterflies undoubtedly would adopt the regular alternation of wet and dry season forms seen in their relatives in India.

Indeed, two other of our butterflies, the hop merchant (*Polygonia comma*) and the question mark (*Polygonia interrogationis*), have a light-colored, long-winged dry season form which appears late in the summer, lives through the winter, and flies again in spring, and a dark-colored, short-winged wet midsummer form. While the autumn

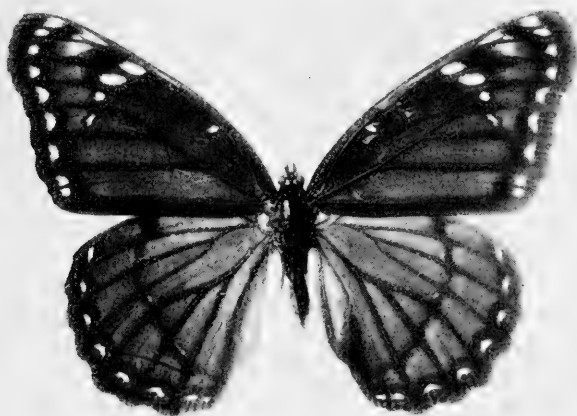


FIG. 92.—Viceroy (*Basilarchia archippus*); September 10, 1928.

brood of these two butterflies is always exclusively of the light-colored, long-winged dry season form, individuals of this form sometimes occur in the summer brood. Besides, the light form is not so strongly marked as it is further north.

An extraordinary mixing of the different forms is seen in the orange clover butterfly (*Eurymus corytheme*) which, normally of only casual occurrence, has for the past two years been extremely common. In northern Texas, as described by Boll, the first individuals to appear are of the form called *ariadne*, small and pale yellow with a faint flush of orange on the lower part of the fore wings. The butterflies of the next brood (form *keewaydin*) are much larger, and the orange is of a deeper and brighter tint and covers a much more extensive area. The butterflies of the next two broods are large and

almost entirely deep orange which in the males has a beautiful violet iridescence. These last represent a wet form of the species, the *keewaydin* type is intermediate, and the small yellow individuals (form *ariadne*) represent the dry form.

In the District the driest season is in the late summer and the wettest in the spring. So in this region the various types of this unusually interesting butterfly are curiously mixed. The earliest individuals are of the brilliant orange form, which is the last to appear in Texas. This persists throughout the season, and in boggy pastures near the river reaches an immense size. In the middle of July the intermediate form (*keewaydin*) begins to become common, flying with the other. In late summer the small yellow form with a slight flush of orange is also to be found, in company with the other two. Here we have an example of a butterfly in a new region adapting itself to varying conditions within a restricted area by the production of forms which elsewhere have a seasonal significance, after the fashion of the buck-eye (*Junonia cana*).

In a region permanently or seasonally wet, vegetation is everywhere luxuriant, while in a region permanently or seasonally dry, growing plants are relatively few and widely scattered. In correlation with this, the dry forms of our local butterflies are as a rule much more active than the wet. They have longer fore wings and are more inclined to wander. As a concrete illustration I may mention the difference in the habits of the hop merchant (*Polygonia comma*) and the question mark (*Polygonia interrogationis*) in summer and in autumn.

The dark, short-winged summer individuals are mostly found in deciduous woods, especially along wood roads, in open glades, and along the borders of wooded districts. While shy and active, they seldom stray far from their place of origin.

The light, long-winged autumn individuals are at first found in deciduous woods, flying with worn examples of the dark parent form. But later they largely desert the woods and become widely dispersed throughout the open country, where they are especially to be found along the roads, the bare earth of which is warmed by the sun of the cool autumn days. When startled these light-colored individuals fly away and seldom return to the place they left.

Pressure of population among the butterflies gives rise to the appearance of phenomena also seen in man under similar conditions. Perhaps the commonest of these phenomena is haphazard wandering. Many butterflies in early spring when the individuals are few in number must be sought for in their proper habitats, to which they are



FIG. 93.—Orange clover butterfly (*Eurymus corytheme*). A, Form *ariadne*, male; light yellow with a faint flush of orange on the inner portion of the fore wings; July 23, 1927. B, Form *ariadne*, female; light yellow with a faint flush of orange on the inner portion of the fore wings; August 6, 1927. C, Very large deep orange female; September 11, 1928. D, Female with the spots within the black border of the fore wings orange; October 7, 1928. E, White female with a very faint flush of salmon pink on the inner portion of the fore wings, and of yellow on the hind wings; October 7, 1928. F, Bright yellow female with scarcely a trace of orange; September 14, 1928.

confined more or less strictly. Beyond those areas are seen only occasional individuals, which in most forms are always males. Later in the year, when the individuals are very numerous, both sexes wander and become of general occurrence, though away from the normal habitat, males are almost always much more numerous.

In some species, as for instance in the cloudless sulphur (*Catopsilia sennæ*), the males will flock together and go on exploring expeditions, sometimes traversing large areas never visited by females. In others the males will congregate on muddy spots where they may occasionally be seen in enormous companies sucking up the moisture. This is especially the case with the yellow clover butterfly (*Eurymus philodice*), the lesser sulphur (*Eurema lisa*), and the yellow (*Papilio glaucus*) and white or zebra (*Papilio protosilaus*) swallowtails. These companies of males sociably imbibing moisture suggest men's clubs in a city.

In other species, as the pearl crescent (*Phyciodes tharos*), the buckeye (*Junonia cæna*), and the viceroy (*Basilarchia archippus*), the males wander away and gather along roads or the borders of waste places. Here they become excessively pugnacious. They attack each other and dart viciously at bees, wasps, grasshoppers, and other insects that fly near them. They cannot in any way harm these objects of their spite, but they do their best to worry them. I have seen a male pearl crescent by a furious onslaught on an immensely larger milkweed butterfly (*Danaus menippe*) cause it to fly awkwardly from side to side, at the same time rising in a desperate endeavor to shake off its puny adversary.

These belligerent male butterflies striving to prevent passage across their lines into an overpopulated area are acting in defense of their species' food supply. They show a curious correspondence to the military lines drawn around human social units for the same purpose.

While the males of most butterflies are more or less pugnacious, their pugnacity rapidly increasing with increasing numbers, some butterflies are pacifists and will not fight. This is the case, for instance, with the milkweed butterfly (*Danaus menippe*). A very curious characteristic of this insect is that the sexes seem to be alike in all their habits, and when on the wing can only be distinguished by the brighter color of the males. This butterfly is remarkable for its autumnal migratory flights in enormous flocks which, unlike the so-called migratory flights of many other butterflies, include both sexes.

Comparatively little has been done on the more intricate details of the natural history of the butterflies, and it is hoped by a continuation of these studies to clear up many points that now seem obscure.

STUDYING FERNS IN EUROPEAN HERBARIA

BY WILLIAM R. MAXON,

Associate Curator, Division of Plants, U. S. National Museum

In furtherance of studies upon which I have been engaged intermittently for many years, I was enabled last summer to visit Europe and to carry on work at several botanical institutions, with the view of preparing a descriptive account of the fern flora of Jamaica. Extensive field work by myself and others at intervals since 1900 had yielded large series of specimens which in themselves might seem to afford a sufficient basis, yet there existed the need of comparing many of these with the original (type) specimens in European herbaria and re-identifying much other material, in order to settle many points of identity not only, but of relationship and range as well.

Mention has been made previously¹ of the important position occupied by Jamaica with respect to current studies of the tropical American fern flora—a flora surprisingly rich, even to those most familiar with it. The first New World ferns to be described in any number were West Indian, and of those that received scientific names in the modern sense a large proportion were from Jamaica. For differing reasons, many of these names, given originally to characteristic Jamaican species, have since been applied loosely or quite erroneously to related plants from other regions; from which it follows that progress in describing properly the diverse tropical American fern flora as a whole must be dependent largely upon having first an accurate knowledge of the ferns of Jamaica. Though obvious, the point has been often overlooked in recent work.

I sailed from New York for Southampton July 4, and on the return passage reached New York October 12. Most of the intervening period was passed in London, studying at the British Museum (Natural History) and the Royal Botanic Gardens, Kew. At the former institution several days were given first to a critical re-examination of the Jamaican ferns collected in 1687-89 by Sir Hans Sloane, virtual founder of the British Museum; many of these were faithfully illustrated in his "History" of the island, and served as the partial basis for numerous new species proposed by later writers.

¹ Smithsonian Misc. Coll. Vol. 78, No. 7, pp. 100-111, figs. 110-118, 1927.



FIG. 94.—The historic Herbarium Building. Royal Botanic Gardens, Kew.



FIG. 95.—Herbarium interior, Kew, showing three galleries of one wing. The Herbarium contains upward of 4,000,000 specimens.

Of special interest also were Jamaican specimens collected in the 18th century by Houstoun, William Wright, Dancer, Roger Shakespeare, Masson, and Wiles, and well preserved material gathered in



FIG. 96.—Pond, Royal Botanic Gardens, Kew.

the last century by numerous collectors, chiefly Bancroft, Heward, Macfadyen, Hartweg, Purdie, Gosse, Wilson, Alexander, and March, besides the more recent collections by Nock, Jenman, Sherring, Fawcett, Morris, Hart, and Harris. Here too is found the herbarium of

John Smith, for many years curator of the Royal Botanic Gardens, Kew, who built up the superb collection of living ferns at that institution.

The Kew fern herbarium is composed of material from very much the same sources as those just mentioned, in so far as Jamaica itself is concerned, but it is much richer from the standpoint of general fern study, owing to life-long interest in this group on the part of two famous former directors, Sir William Hooker and Mr. J. G. Baker, and the peculiarly favorable official and personal relations that existed during a long period of remarkable activity in world-wide botanical exploration. In wealth of historic material it is unrivaled.



FIG. 97.—A view in the Botanical Garden, Copenhagen. The Botanical Museum is near by.

The beautiful Gardens as well bear eloquent testimony to the devoted and enlightened support accorded this institution for generations.

It was at Stockholm, however, that the largest number of type specimens bearing directly upon the Jamaican problem were encountered. Here, in the beautiful new Riksmuseet building near the northern boundary of the city, are preserved most of the original specimens collected in Jamaica by the illustrious Swedish botanist, Olof Swartz, in 1784-86, and described by him; and I was able to make nearly all desired comparisons, these based not only on specimens that Swartz had retained in his own herbarium, but in scores of cases substantiated also by specimens presented by him to contemporaneous Swedish botanists, whose collections eventually have come to the Museum.

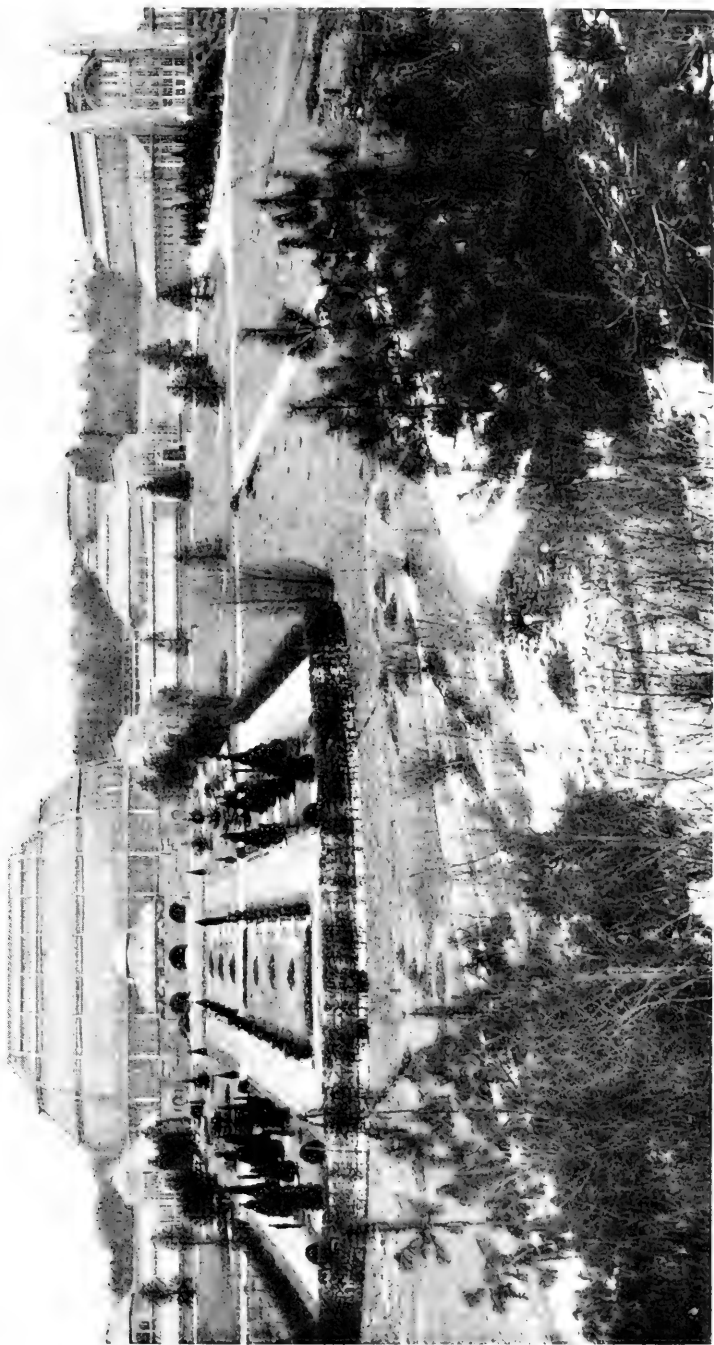


FIG. 98.—A general view of the conservatories, Botanischer Garten, Berlin-Dahlem.

Swartz was in close touch also with the German botanist, Willdenow, and in the beautifully preserved Willdenovian herbarium at the Berlin Botanical Museum I found many of his duplicates, these agreeing almost without exception with the Stockholm material so named. Willdenow's own tropical American species were examined as carefully as time permitted, and the period of six days devoted to this study and to examining fern material in the rich general herbarium at Berlin proved all too brief.

On the way to Germany I had the privilege of spending several days at the Botanisk Museum, Copenhagen, with Dr. Carl Christensen, leading world authority on Pteridophyta, and of discussing with him



FIG. 99.—A small section of the exhibit of living Cacti. Botanischer Garten, Berlin-Dahlem.

many problems of mutual concern in connection with our work upon this group. Of particular interest were the types of numerous species proposed long ago by Liebmann, from Mexico.

Substantial progress in the Jamaican work was made during the summer, and the trip was profitable in other ways. It was made possible through generous support extended by the American Association for the Advancement of Science, the Smithsonian Institution, the New York Botanical Garden, and the British Museum (Natural History). The manuscript is to be published by the last institution.

To the directors and curators of the institutions visited is offered a very sincere expression of appreciation of assistance and innumerable courtesies extended.

BOTANICAL EXPLORATION IN HONDURAS

By PAUL C. STANDLEY,

Associate Curator, Division of Plants, U. S. National Museum

In comparison with other Central American countries, the flora of Honduras and Nicaragua is virtually unknown. As a step toward remedying this condition the writer spent the period from December, 1927 to March, 1928, inclusive, in botanical exploration in northern and central Honduras, the work having been undertaken by the National Museum in cooperation with the Arnold Arboretum, the United Fruit Company, and the Lancetilla Experiment Station of the Tela Railroad Company.

Headquarters for the work was established at Lancetilla Station, three miles south of the port of Tela, the most important shipping point for bananas from the Honduran coast. The station, under the direction of Wilson Popenoe, is devoted to experimental work with bananas and to the testing of new plants of possible economic value in Central America. There has been assembled at Lancetilla a large variety of useful plants from all parts of the tropics, and the station promises to become an important center for horticultural work. Of greatest interest, perhaps, at the present time, are several hundred young mangosteen trees. The mangosteen is considered by those who know it to be the finest of all tropical fruits, but no attempt has been made previously to grow it upon a large scale in America.

The greater part of the winter was spent in studying the flora of Lancetilla Valley, about the station. A large collection of plants was obtained, representing not only the flowering plants and ferns but also the lower cryptogams, to serve as the basis of a proposed flora of the valley now in course of preparation. This wet lowland region was found to be a rich one from the botanical standpoint, especially in trees, and it is believed that the collections obtained contain a substantial number of undescribed or otherwise interesting species.

Lancetilla is an ideal headquarters for field work because of the excellent living conditions which it affords, and also because of its proximity to interesting collecting grounds. After a walk of 10 minutes from the office one reaches virgin forest, composed of a



FIG. 100.—The port of Tela, Honduras.



FIG. 101.—A typical swamp scene in the lowlands near Tela, Honduras.

great variety of important timber trees. The number of palm species in the undergrowth is surprisingly large, the most abundant and conspicuous being the familiar cohune or corozo (*Attalea cohune*), with which are associated *Chamaedoreas*, a *Malortia*, *Geonomas*, and many others. From one of the common palms, formidably armed with long, stout, flattened spines, and known locally as *lancetilla*, the valley and station derive their name.

The hills which confine the valley rise to a height of 2,000 feet, thus affording a variety of plant life seldom found so near the coast.



FIG. 102.—View across the grounds of Lancetilla Experiment Station. The hills rise to 2,000 feet, and are covered with virgin forest.

The large trees on the very humid hilltops, above the corozo forests, are loaded with a luxuriant growth of epiphytic plants, among which ferns, orchids, bromeliads, aroids, and mosses predominate.

An interesting sight at Lancetilla is the serpentarium of the Antivenin Institute of America, where are kept large numbers of poisonous snakes. From the vicious *barba amarilla* and the giant Honduran rattlesnake, venom is extracted from which is prepared a serum for use in treating persons bitten by these serpents. This is the only establishment of its kind north of Brazil.



FIG. 103.—Typical laborers' dwellings of the north coast of Honduras. The palms are *Attalea cohune*, and the huts are thatched with their leaves.

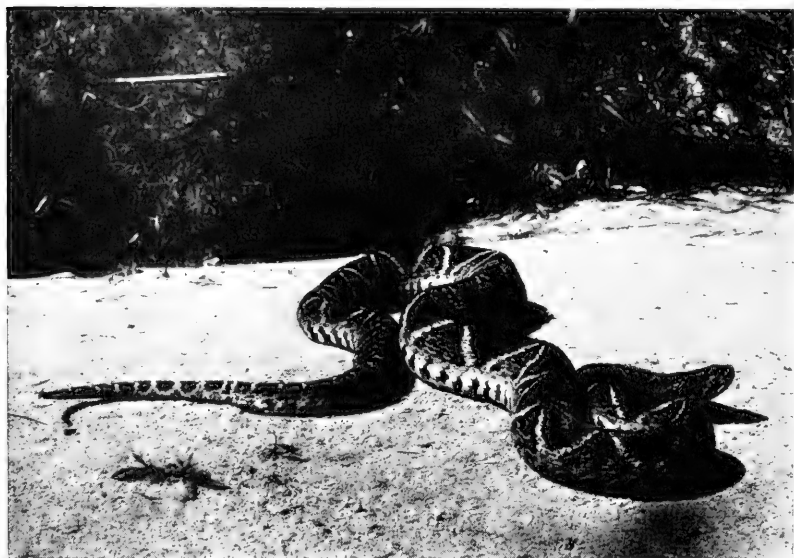


FIG. 104.—A barba amarilla, the most venomous of Central American snakes.

Three weeks were spent also in the interior of Honduras, and I traveled as far as the capital, Tegucigalpa. Travel in the interior of Honduras is now easy because of the completion by the government of an excellent automobile road which runs from Lake Yojoa, at the end of one of the railroads of the Atlantic coast, across several ranges of high mountains to Tegucigalpa, and on to the Pacific coast. Tegucigalpa is almost the only capital in the world not reached by a railroad.

It is a satisfaction to know that this fine road was planned and constructed by Honduran engineers. Over the difficult mountains it is a succession of steep grades and hairpin curves, which would thrill the traveler more if it were not for the careful native chauffeurs, who are probably the most expert drivers in Central America. The road unfolds to view one beautiful vista after another, for nowhere else in Central America will one find more majestic and varied scenery.

Extensive collections were made about Siguatepeque, in central Honduras. This is a comparatively dry, mountainous region of pine forests, lying at an elevation of 3,500 to 6,000 feet. The general aspect of the country recalls the Rocky Mountains of southern Colorado and northern New Mexico. Not only are the Honduran pines strongly suggestive of the common yellow pine of the Rockies, but the appearance of the rather sparse undergrowth likewise is very similar. Curiously enough, there occur here in the higher mountains a hop hornbeam (*Ostrya*), the sweetgum (*Liquidambar styraciflua*), the royal and cinnamon ferns, and bracken, all of which are common plants of the eastern United States. The vegetation of central Honduras seems to be closely related to that of some parts of non-tropical southern Mexico. This fact is emphasized by the abundance of *Parosela* species, and by the large number of handsome red- and blue-flowered *Salvias*.

It was a disappointment that lack of time made it impossible to collect in the Comayagua Valley, which is crossed by the road from Siguatepeque to Tegucigalpa. This huge valley, encircled by high mountains, is almost a desert, resembling the Zacapa Desert of Guatemala, and one of the few such areas existing in Central America. One is reminded strongly of the deserts of Mexico by the scrubby thickets and bare dusty stretches about Comayagua. One of the common plants is a stately *Agave*, and there is a profusion of cactuses, among them small prostrate prickly-pears, and other *Opuntias* which grow as trees 30 feet high, climbing *Cereus* species with slender

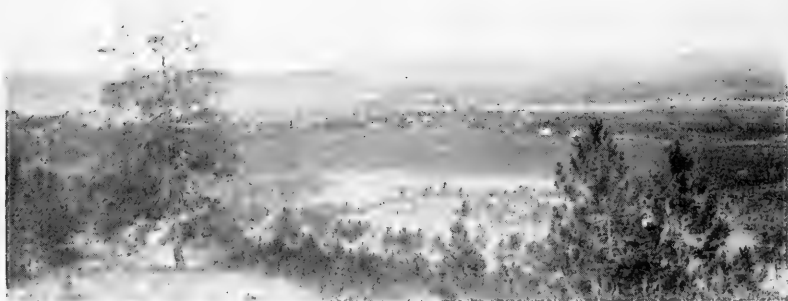


FIG. 105.—View of Siguatepeque, typical of the mountain scenery of central Honduras.



FIG. 106.—Characteristic pine forest near Siguatepeque, Honduras.

angled stems, a large Echinocactus or barrel cactus, with stout hooked spines, and one or more Cephalocereus species, their tall, simple or branched, columnar stems covered at the tip with bunches of long white hair.

In all, about 4,300 numbers of plants, represented by approximately 13,000 specimens, were collected in the course of the season's



FIG. 107.—A *Furcraea* in flower, Siguatepeque, Honduras.

work. The collections are now being studied at the Field Museum of Natural History.

The field work in Honduras was facilitated in every possible manner by the officials of the Tela Railroad Company, to whom thanks are due for the success of the expedition. Special acknowledgments are made to Wilson Popenoe, who furnished at Lancetilla such admirable

facilities for the exploration of that region ; to Alfred F. Butler, whose constant attention made the work so agreeable ; and to Frederick Coville, who made more than 100 photographs of characteristic plants of the Lancetilla Valley.

COLLECTING GRASSES IN NEWFOUNDLAND AND LABRADOR

By A. S. HITCHCOCK,

Custodian, Section of Grasses, U. S. National Museum

For the purpose of obtaining much-needed material representative of the extreme northeast, I visited Newfoundland and Labrador during July and August, 1928, to study and collect grasses. The settlements in Newfoundland are chiefly along the coast, since from the earliest occupation by the white man the basic industry has been fishing. Recently a railroad has been built across the island from Port-aux-Basques at the southwest corner to St. John's, the capital, near the southeast corner. The road, however, runs north from Port-aux-Basques, through St. Georges to Corner Brook, then turns east, passing through Grand Falls, and finally turns to the southeast, thus making a large bend to the north. There are a few towns in the interior along this railroad, but in the main the central part of the island is a vast wilderness.

Two large pulp mills are located at Corner Brook and Grand Falls, and the manufacture of paper from pulp wood is a rather recent and flourishing industry. There is some mining and agriculture, but these are distinctly minor activities.

Collections of grasses were made at Port-aux-Basques, St. Georges, Corner Brook, Little Harbor (on Deer Lake, north of Corner Brook), Grand Falls, and St. John's. The number of species of grasses decreases in North America as one goes north, and in Newfoundland the number is further diminished because it is an island. About 12 species may be said to be common throughout the island. Among these the bent grasses (*Agrostis*), with four species, and the blue-grasses (*Poa*), with two species, take the lead. About 40 species of grasses were collected, but many were comparatively rare. A few were found commonly in restricted areas, as, for example, two species of beach grasses (*Ammophila* and *Elymus*), found on sandy sea beaches. The area occupied by these is restricted, because the shores of the island are mostly rocky and precipitous.

A short trip to Labrador was made during August. A steamer runs regularly at intervals of about 18 days from St. John's to various ports in Labrador as far north as Hopedale (Lat. $55\frac{1}{2}^{\circ}$) or sometimes to Nain (Lat. $56\frac{1}{2}^{\circ}$). In order to have time for collecting I



FIG. 108.—Bonne Bay, on the west coast of Newfoundland, north of Humber Mouth. The treeless slopes and the neat white houses are typical of the fishing villages.



FIG. 100.—Glacial boulder at Holyrood (near St. John's), Newfoundland. Much of the island is glaciated and boulders have been freely deposited. This one is conspicuous because of its size and its position in the street of a town.

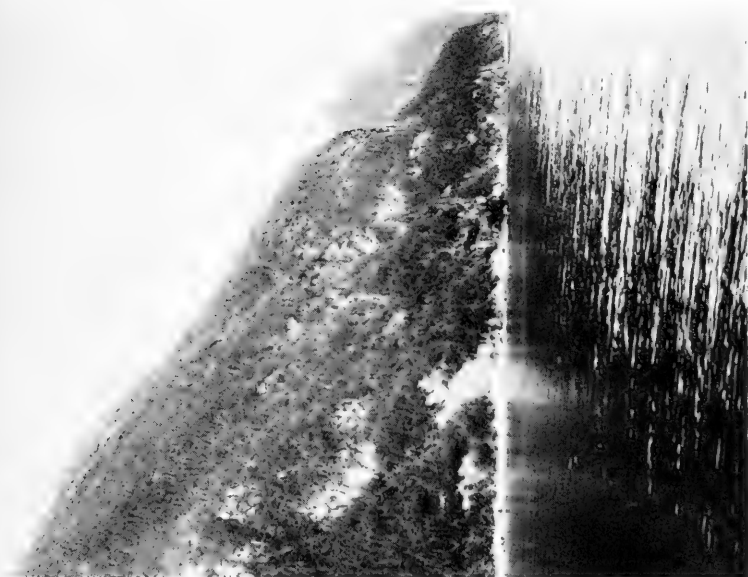


FIG. 111.—A rocky cape at Webbers Cove, Labrador. This scene is typical of the Labrador coast, though it is only in protected places that so much forest is seen.

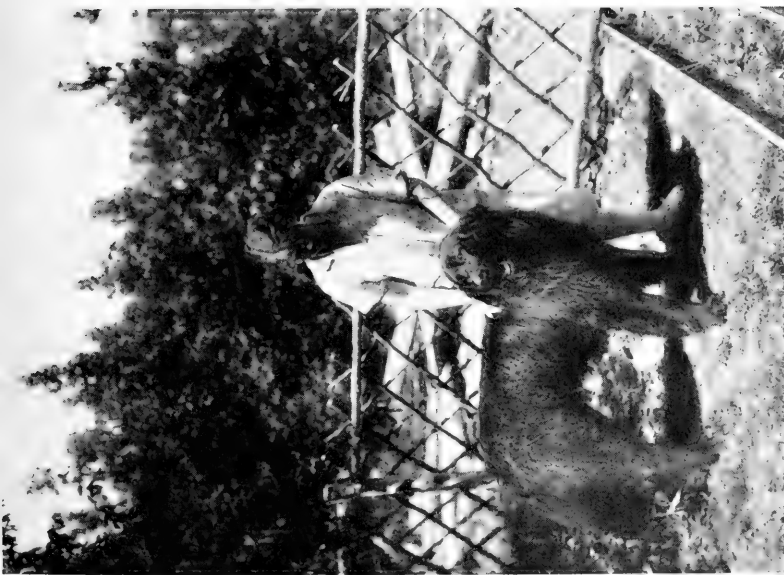


FIG. 110.—Newfoundland dog, belonging to Mr. Turner, Little Harbor. This breed is characteristic of Newfoundland. It is represented on certain issues of the island's postage stamps (as are also the codfish, the seal, and the caribou).



FIG. 112.—The church at Cartwright, Labrador. The good people of the fishing villages are well supplied with religious edifices. Cartwright is a Hudson Bay Company's post.



FIG. 113.—The school at Cartwright, Labrador. The scrubby timber consists of black spruce, balsam fir, and larch.



FIG. 114.—Stunted growths of spruce and fir on the wind-swept shore of the bay at Cartwright, Labrador. The snows and winter winds flatten out all forest growth in exposed places.



FIG. 115.—Beach grass (*Elymus mollis*) along the sandy shore of the bay at Cartwright, Labrador. This grass is found on sandy shores of the northern part of North America, but is not common in Labrador and Newfoundland because the shores there are mostly rocky and precipitous.

stopped at Cartwright (about Lat. 54°), while the steamer went north to Hopedale, and took the boat on its return, leaving it again at Battle Harbor, situated near the southeast corner of Labrador. I remained at Cartwright five days and at Battle Harbor from the evening of one day to the morning of the third day.

Labrador is a bleak and rather barren land along the coast. The numerous inlets and bays are rocky and precipitous. The interior is forested, but there are no trees near the coast except in protected



FIG. 116.—Fireweed (*Chamaenerion angustifolium*), Cartwright, Labrador. This conspicuous plant, common in all northern lands, is called fireweed because it springs up abundantly in burned areas.

places. Through the courtesy of the Hudson Bay Company my stay at Cartwright was very pleasant.

At Battle Harbor there is a Grenfell Hospital which is open during the summer months. The main hospital is at St. Anthony, on the east side of the north end of the peninsula that extends toward Labrador. As the steamer stopped here on its journey north I was able to inspect the large and well-equipped hospital and the industrial school.

Altogether the results of the trip were very satisfactory. A large series of grass specimens was brought back and first hand information of a portion of this extreme northeastern region was obtained.

COLLECTING GRASSES IN THE SOUTHWEST

By JASON R. SWALLEN,

The grasses of the Southwest form an exceedingly interesting element of the United States grass flora. With a view to studying certain species in localities which have been little visited by botanists, I spent the past summer collecting in the states of Arkansas, Oklahoma, Texas, New Mexico, and Colorado.

In Oklahoma, a short visit was made to the Wichita Mountains, the highest range in the state, although they are little more than high hills. The area has been set aside as a national forest and game preserve, affording refuge for buffalo, elk, deer, and antelope. Around a central plain which provides forage for numerous cattle, there are rugged rocky slopes rather sparsely covered with small oaks and pines. For the most part the flora is very much the same as that of the surrounding plains.

As the season was a very dry one in western Texas, the collecting was not especially good. However, I made a trip to the Chisos Mountains about 60 miles south of Alpine. Some of the slopes are entirely void of a ground cover, while others support a more or less dense vegetation of grass, shrub, and in places small pine trees. Toward the summit of the mountains I found a species of bluegrass (*Poa involuta* Hitchc.) which had been collected only once before, and is apparently local and confined in distribution to this region. Short visits were also made in Texas to Corpus Christi and Edinburg.

The work in Colorado was almost entirely confined to high altitudes, for the purpose of studying the species of the genus *Poa*. It was also hoped to establish new localities for some rare alpine grasses, but without success. Trips were made to Mount Wilson in the San Miguel Mountains, Mt. Massive, Grays and Torreys Peaks, the Park Range west of Steamboat Springs, and the Spanish Peaks. One of the striking features of the flora of Colorado is the way in which the desert vegetation extends far up the valleys at comparatively high altitudes to the very base of the mountains, indicating that Colorado is essentially an arid region. In many places these valleys are irrigated, converting them into valuable and productive land.

The scenery among the high peaks of the mountains and in the deep gorges of the rivers is often magnificent, but it must be admitted that



FIG. 117.—A view of the sand dunes on Mustang Island off the coast of Texas near Corpus Christi. The dominant grass on the dunes is *Uniola paniculata* L.



FIG. 118.—Mt. Wilson, San Miguel Mountains, Colorado. The scenery in this region is less marred by forest fires and lumbering operations than is often the case in this state.



FIG. 119.—Rabbit Ear Mountain, Colorado. From the top of the "ears," an excellent view of the Park Range is obtained. Pasture is good in this region, providing forage for herds of sheep.



FIG. 120.—Grays and Torreys Peaks, Colorado, as seen from Mt. Kelso. On the upper slopes of Grays Peak, the one to the left, *Poa lettermani* is very abundant.

the beauty of the wooded slopes is greatly marred by the extensive areas of devastation caused by forest fires or by lumbering operations. There were evidences of this in practically every locality that I visited, the present stand being almost entirely composed of second growth timber. Where the devastation has been more recent, aspens often cover large areas with a dense growth, especially at the higher altitudes. In many places the charred remains of the trees stand as evidence of the destruction wrought. The efforts of the Forest Service, however, are of the greatest value in the preservation of this natural resource and in the reforestation of the lands already laid waste, for the use of future generations. This is necessarily a slow process which will extend over a long period of time.

The mining industry has also taken its toll. Wherever mines have been developed on a large scale, the results have always been the same—the almost complete ruin of natural beauty.

Collecting in Colorado was excellent, especially at high altitudes, affording a good opportunity to study the grasses in their natural surroundings. During the summer I collected about 500 numbers of grasses, many of which were extensions of known ranges as represented in the National Herbarium.

ARCHEOLOGICAL FIELD-WORK IN CHINA

By C. W. BISHOP,

Associate Curator, Freer Gallery of Art

After the return from China of the American portion of the Freer Gallery Expedition staff in the spring of 1927, field-work was continued by its Chinese members, Dr. C. Li and Mr. K. Z. Tung.

Dr. Li, whose excavations in southwestern Shansi province have already been noticed,¹ devoted the spring and summer of 1927 to the study of his finds and the preparation of his preliminary report in Chinese and English. The Chinese version was published early in September, 1927, as one of the series of scientific reports of the Research Institute of Tsing Hua University, Peking.

Dr. Li had planned to return to Shansi in the early autumn and establish a field base for permanent work in that area, among the most interesting archeologically in all China. He was prevented, however, by the outbreak of hostilities between the party then in power at Peking, and the province of Shansi. He therefore attempted a task which the Freer Gallery Expedition has long had in mind, the archeological exploration of the valley of the Han River, in Central China, an important avenue of war and trade and migration from the earliest times. In pursuance of these plans, Dr. Li proceeded by sea to Shanghai and thence up the Yangtze River to Nanking, this circuitous route being necessitated by the civil war then going on.

Dr. Li held a number of important conferences with members of the Scientific Research Institute of the newly established National Government, with the object of arranging methods of mutually beneficial cooperation between that organization and the Smithsonian Institution. In the course of these, Dr. Li was requested by the Chinese Government to help organize departments of anthropology and archeology. He then proceeded up the river to Hankow, only to learn that the almost universal prevalence of banditry in that part of China

¹ Explorations and Field-Work of the Smithsonian Institution in 1926. Smithsonian Misc. Coll., Vol. 78, No. 7. pp. 123-137, and *Ibid*; Smithsonian Publ. No. 2957, 1927, pp. 114-118.



FIG. 121.—Scene on the Yangtse River with junks in a brisk breeze.



FIG. 122.—Group of Mongols near Shangtu.

would make it impossible for him to carry out his projected exploration of the Han River valley.

He therefore started north late in January, to try to visit the historically and archeologically very important areas centering about the Great Bend region of the Yellow River. He was permitted, by grace of the military, to travel in an unheated baggage car, through rain and sleet and snow, and on one occasion, when his train was caught between two hostile forces, he was for a time under somewhat heavy fire, bullets passing through the car in which he was riding.

It was at this time that events were shaping themselves for the final push which resulted in the occupation of Peking by the National Government, and Dr. Li, convinced after a thorough trial that field-work for the time being was out of the question, returned to Peking over the same circuitous route by which he had come.

While he was unable to accomplish anything of importance in the way of field-work in this journey, the contacts which he established with the new National Government for the promotion of scientific research, particularly in archeology, are of great importance and will undoubtedly be productive of much good in the near future.

Dr. Li had been instructed, in the event of the civil war making field-work impossible, to come to Washington. He arrived late in May of the current year and spent a busy summer in preparing the English version of his report, in visiting important centers of archeological study in this country and in discussions with members of the Smithsonian staff and others interested in research in China. On August 10, he sailed for Europe, and should at present writing have returned to Peking after making further arrangements with the Chinese Government at Nanking, the new capital, for cooperative field-work.

In the spring of 1927 excavations were undertaken in the Liaotung Peninsula of Manchuria by Dr. K. Hamada of the Imperial University of Kyoto, Japan. In these Mr. K. Z. Tung was invited to participate as the representative of the Freer Gallery Expedition. He therefore proceeded to the city of Dairen, where he joined the party and went to the proposed site, near by. It was successfully excavated, and much of interest was found. A report will be published in due course by the Kyoto Imperial University; but it may be stated here that Dr. Hamada believes that the place was a port of call in early times for voyagers between China and Korea.



FIG. 123.—Camel train. Most of the carrying trade of Mongolia is done by camel caravans.



FIG. 124.—Pass leading from Kalgan up into the plateau of Mongolia.



FIG. 125.—Mongol Lama or Buddhist priest. The Mongols are devoted adherents of Tibetan Buddhism.

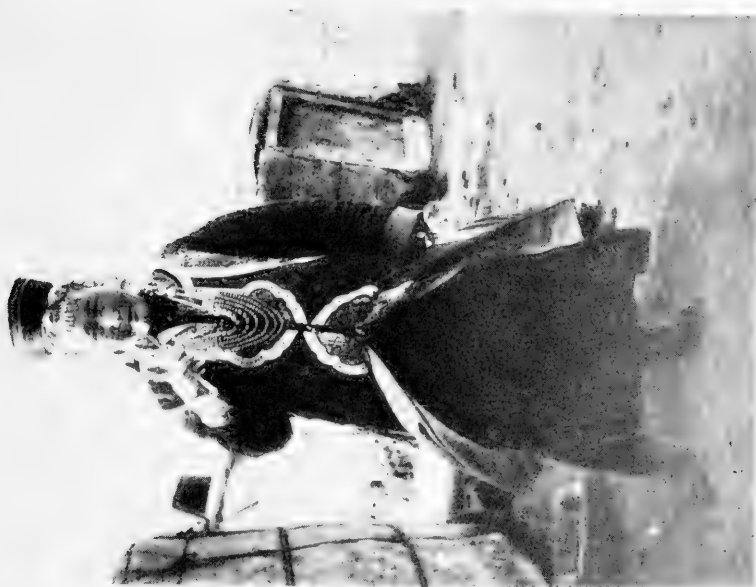


FIG. 126.—Mongol woman of rank, showing elaborate head-dress.

Dr. Hamada later in the same year visited Washington, where he was welcomed by the staff of the Smithsonian Institution. It may be stated here, parenthetically, that the efforts constantly being made by the Institution to conduct scientific research along various lines in close and friendly cooperation with kindred bodies in other lands, is one of the most effective although least widely advertised means of promoting goodwill and friendship among the nations.

After his return to Peking, Mr. Tung was able to visit various localities of archeological importance, although his activities, like those of Dr. Li, were greatly curtailed by the civil war then going on. In the early spring of the present year he paid a visit to the new capital, Nanking, and effected further contacts with the members of the government on behalf of the Freer Gallery Expedition.

Mr. Tung next essayed a visit to the site of the old summer capital of the Mongol Dynasty, Shangtu, or Xanadu as it is spelled in Coleridge's well known poem, "Kubla Khan." This lies in Inner Mongolia, about 200 miles north of Peking, and excavation there should reveal much of interest about the great days described for us in the pages of Marco Polo.

Owing to the prevailing hostilities, Mr. Tung's first attempt to reach Shangtu was unsuccessful and he only succeeded with much difficulty and even danger—from risk of typhus, molestation by disorderly troops, and the like—in regaining Peking.

He persevered in his efforts, however, and met with better success on his second attempt. He proceeded by rail to Kalgan, about a hundred miles northwest of Peking, and then hired an American motor-car with which he succeeded in reaching Shangtu. He was accompanied by a representative of the Peking Historical Museum, an institution with which the Freer Gallery Expedition has worked in close cooperation for several years past, and by the former Abbot of the Lama Temple of Peking. Through the good offices of the latter, Mr. Tung was enabled to meet various Mongol chieftains, and to establish friendly relations with them with a view to the exploration and possible eventual excavation of the site.

In concluding this very condensed sketch of the activities of the Freer Gallery of Art in the field—activities carried on in the face of many difficulties, hardships, and even dangers—it may be stated that Mr. A. G. Wenley, who for the past two years has been in Paris working under the eminent French sinologues, proceeded during the past autumn to Japan for further study.



FIG. 127.—North wall of Shangtu, the old summer capital of the Mongol Emperors. Mr. Tung's motor-car in foreground.



FIG. 128.—Ruins of Shangtu, the old summer capital of the Mongol emperors of China.

The year 1928 draws to a close with conditions in China vastly improved, and there is every reason to expect that the Freer Gallery Expedition will be able to accomplish during 1929 much of fundamental importance to a correct understanding and interpretation of the great Chinese civilization.

THE ANCIENT ESKIMO CULTURE OF NORTHWESTERN ALASKA

By HENRY B. COLLINS, JR.,

Assistant Curator, Division of Ethnology, U. S. National Museum

The archeology of northwestern Alaska has until very recently been wholly unknown. There was, in fact, no general knowledge of the existence of any sites of importance in the region. In 1926 Dr. Aleš Hrdlička, of the Smithsonian Institution, made an anthropological survey of the Alaska coast from Norton Sound to Point Barrow, and Mr. D. Jenness, of the National Museum of Canada, carried on systematic excavations at Cape Prince of Wales and on the Little Diomedé Island. The immediate result of these investigations was to show that there had existed in early times about Bering Strait an Eskimo culture, distinctive in type, and superior in some respects to that found in the same regions to-day. In 1927, with Mr. T. Dale Stewart, I examined the Alaska coast from the Aleutian Islands northward to Norton Sound, but found no trace of this ancient culture. In 1928 I conducted a second expedition, accompanied by Mr. Harry E. Manca of Seattle, for the purpose of excavating on St. Lawrence and Punuk Islands. The work was made possible through the generosity of Mrs. Mary Vaux Walcott, and additional support was received from the Bureau of American Ethnology and the American Association for the Advancement of Science.

We left Seattle May 17 on the U. S. Coast Guard Cutter *Northland*, but the condition of the ice around St. Lawrence and Punuk delayed our landing until June 23. While waiting, however, we made collections of skeletal material at Golofnin Bay and on Sledge Island in Norton Sound.

The three small Punuk Islands lie four miles off the eastern end of St. Lawrence. The largest island, on which the old village is located, is somewhat less than half a mile long. Like the entire eastern half of St. Lawrence, Punuk Island has long been deserted. The nearest Eskimo are those living at the village of Sevunga, on the northern side of St. Lawrence, about 100 miles to the westward. Natives from Sevunga and from Gambell, on the northwestern end of the island, were employed as excavators.

Archeological field-work in this section of Alaska must be carried on under difficulties. There are no regular means of transportation to the more remote areas; there is often no nearly source of labor or supplies; wood for fuel is often scarce and on Punuk suitable drinking water was lacking. The weather is extremely disagreeable and on the Bering Sea islands, in particular, high winds, cold, fog, and rains generally prevail throughout the summer. Added to these inconvenient features the work of excavating is made unusually difficult



FIG. 129.—Paul Silook and Steven Istivik, St. Lawrence Island Eskimos, cutting up a walrus they shot at Punuk. Walrus blubber is the principal food of the St. Lawrence Islanders.

because of the permanently frozen ground, which makes it necessary to strip off the earth in layers of only a few inches thickness, allowing the atmosphere to thaw out the exposed surface before repeating the process.

Viewed from the sea on either side, the Punuk village site appears as a six-foot mound rising from the level surface of the land and occupying the entire space across a narrow neck of the island. Sunk into its top are the square pits of the old houses, which were constructed of drift wood and whale bones, and the underground caches



FIG. 130.—East Cape, St. Lawrence Island, as seen from Penuk Island.



FIG. 131.—The western end of Penuk Island. The expedition camp is seen just beyond the ruins of the old village, and still further a few ruined dwellings of a much later period.

in which whale bones alone were used. The entire mound was found to be a natural accumulation of refuse, built up by slow degrees by generations of Eskimos who had lived on the spot. The total extent of this kitchen-midden was even greater than it appeared, for it was found to extend several feet below the present beach, giving it at one point a height of 16 feet. A short distance from the midden are a few detached houses belonging probably to the same period, and still further toward the end of the island are the ruins of several



FIG. 132.—One of the expedition's two tents on Punuk Island. In the background is seen the hill that gives to the Island its Eskimo name, Poongook, from Poongwa, or "Little Hill."

later houses, abandoned 40 or 50 years ago. Three of the later houses and two of the older ones were excavated in addition to sections cut into the midden.

The sloping lower parts of the midden were buried beneath several feet of sand and rocks that had been washed up by the sea. Several old houses were found at the very bottom of the midden, the deepest of them six feet below the present upper beach line, which was reached by the waves on two occasions during our stay on the island. These houses when built were, of course, like all Eskimo houses, well

above the reach of the sea. A considerable period of time must be allowed to account for the sinking of the land or the encroachment of the sea to such an extent.

In addition to the evidence of the sinking of the land, the antiquity of the Punuk village site is attested by the enormous accumulation of refuse, by the leveled and filled-in appearance of the house pits, and most significant of all, by the large number of implements, weapons, and other objects differing markedly from those used by the modern Eskimo. Among the objects from the later houses were iron tools of many kinds; closed-socket thick harpoon heads with metal blades; relatively flat adz heads; and small ivory bird figures. In contrast to these forms the older village yielded open-socket thin harpoon heads with slate blades; closed-socket heads of a distinctive type, usually decorated; "shoe-shaped" adz heads; drills of bone and ivory; spear thrower and peg insets for butt of darts used with it; and plummet shaped ivory fish line sinkers. Among the several thousand specimens excavated from the older site there were only four small pieces of iron and two blue glass beads, all of which came from a depth no greater than 16 inches.

The incised ornamentation appearing on many of the bone and ivory objects from the old village is of a type heretofore known from a few random specimens from St. Lawrence Island. In its most typical form it consists of dots and gracefully incised lines, straight or slightly curved, into which red ochre had often been rubbed. The circle and dot design, employed in conjunction with more typical line decoration, was also found. This Punuk type of Eskimo art appears to be intermediate both in time and in style between the most ancient, which has come to light only within the past three years, and the modern.

With the possible exception of the upper level, the Punuk settlement is prehistoric, though it is later than the old sites such as Kukuliak and Sevuokuk on the northern and northwestern parts of the island. If the few pieces of iron and the two glass beads are to be regarded as properly belonging where found and not as later intrusions they place the abandonment of the village at a time following the entry of the Russians into northeastern Siberia in the middle of the seventeenth century, for shortly thereafter the Alaskan Eskimo secured small quantities of metal in trade from the Chukchi.

Late in July a brief trip was made in a whale boat to Cape Kialegak on the southeastern end of St. Lawrence Island. Here was found an



FIG. 134.—Section of the Punuk midden showing part of an old house beneath 16 feet of refuse and 6 feet below the present beach line.



FIG. 133.—Section of Punuk Island kitchen midden showing old house entrances at bottom, beneath 13 feet of refuse.

old village with a refuse pile of even greater proportions than the one at Punuk. Iron, glass beads, closed-socket harpoon heads and other late types of objects were found on the surface and to a depth of eight feet in the midden. Below that level iron was absent and the old types of artifacts prevailed. A few hundred yards distant was a smaller village site and midden which was entirely prehistoric. The material from this site and from the lower part of the larger midden was practically identical with that from the old village at Punuk. After having lived at the older Kialegak site for a relatively short period—judging from the comparatively small amount of refuse—the inhabitants had abandoned it and moved a short distance up the beach to build the new homes which they occupied until probably 50 years ago. The larger Kialegak site, with the recent material in the upper levels of the midden lying directly above the earlier forms, thus supplemented and afforded a basis of comparison with the Punuk site where the proto-historic period ended rather abruptly at the old village and was succeeded, perhaps after a considerable interval of time, by the houses at the end of the island.

The material from Punuk and Kialegak shows that there are three stages through which the art of St. Lawrence Island may be traced. The earliest (1), found only on the northern and western parts of the island, on deeply patinated objects, consists of scrolls, graceful straight and curved lines, and circles and ellipses made free hand and often surmounting low rounded protuberances; (2) the intermediate stage, typical of Punuk and Cape Kialegak but found also at the northern and western St. Lawrence sites, simpler in design, the lines being graceful but not so flowing, with circles made by compass or drill, and with no protuberances; and finally (3) the well known modern and simplified art found at all of the recent sites.

The work on Punuk Island ended August 17 when the *Northland* came for us. A stop was made at Gambell where I purchased specimens and examined the old village site with Mr. Otto W. Geist, who is excavating for the Alaska School of Mines.

We were next put ashore at Cape Prince of Wales for the purpose of investigating reported ancient sites on the Arctic coast between Wales and Shishmareff. In an Eskimo skin boat we sailed up the coast and camped at Metlatavik, the first of these old villages, 22 miles from Wales. Although many specimens were obtained, nothing of any real antiquity was found. The thickest accumulation of refuse was three feet, throughout which iron occurred. The total absence



FIG. 135.—Partially excavated house of recent period, Punuk Island.



FIG. 136.—Ruined house of the historic period, Punuk Island. The framework was of driftwood logs and whale bones. The houses are square in outline, semisubterranean, and are entered by a long, narrow tunnel.

of the old art, and the almost modern stamp of most of the specimens, shows that Metlatavik was settled in comparatively recent times, probably not earlier than 200 years ago.

There has been in the past a widely held opinion that the original Eskimo culture arose in north central Canada and spread east and west to Greenland and Alaska. The comparatively rich art of the modern Alaskan Eskimo, together with other features of their culture, was thought to have been strongly influenced by later contact with neighboring Indian tribes. On the contrary, it now appears that the modern Alaskan Eskimo are directly descended from a very early, even more advanced Eskimo group that flourished for centuries in and about Bering Strait.

The beginnings of this ancient Eskimo culture remain to be traced. If the lower levels of the middens at the northern and northwestern St. Lawrence sites reveal no evidence of its early development this may very likely be found to have taken place in northeastern Siberia, in the region occupied at present by the Siberian Eskimo or along the Arctic coast immediately to the westward. The reasons favoring Siberia in this regard are the following: The modern St. Lawrence Island and Siberian Eskimo are closely akin, speak the same dialect and maintain trade and social contacts. Our archeological work shows this relationship to have extended back far beyond the historic period. And finally, the old style of art is perfectly represented on a number of specimens from northeastern Siberia that have found their way into various museums.

That this early Alaskan culture exerted a strong influence to the eastward is shown by the recent finds of T. Mathiassen, the Danish archeologist. The Thule culture which he finds in northwest Greenland, Baffin Land, and north of Hudson Bay is the most ancient that has come to light in those regions. It is, however, clearly derived from Alaska, from where it seems to have spread at a relatively late period, after the ancient Alaska culture had established itself on the islands and on both sides of Bering Strait.

Thus we begin to get a somewhat clearer view of the more important early movements of the Eskimo. There have, apparently, been various other and counter movements; strongly localized cultures may have sprung up; and direct or indirect contact with Indian tribes has influenced to a certain degree some of the Eskimo groups. Such movements, growths, and contacts have doubtless had a large part in the development of the present Eskimo groups, from Greenland to Siberia, and yet the archeological evidence, which is the most direct

and tangible evidence at our disposal, seems to indicate clearly enough that the oldest and at the same time the most advanced Eskimo culture centered about Bering Strait. While its origin is not known it is seen to have strongly influenced the extinct Thule culture of Greenland and Canada and to have supplied the greater number of elements making up the culture of the present Eskimo of Alaska and Siberia.

THE "LOST" CALUSA INDIANS OF SOUTHWESTERN FLORIDA

By HENRY B. COLLINS, JR.,

Assistant Curator, Division of Ethnology, U. S. National Museum

Of the more important Indian tribes native to the Southern States none has been so nearly lost to history as the Calusa, who once dominated a large part of western and southern Florida. The first recorded contact of the Calusa with Europeans was in 1513 when they successfully opposed the landing of Ponce de Leon on their shores. In later years they were gradually pushed outward to the more remote keys and decreased in numbers and importance until, about 1835, there was only a remnant left. Of the Calusa language nothing has survived beyond the names of their former villages; information on their customs is likewise scanty, and of their physical type very little is known. Archeology alone can throw light on this latter phase, in addition to supplying data on certain aspects of their material culture, and it was for this purpose that I was detailed by the U. S. National Museum to conduct archeological work in southwest Florida during the winter of 1927-28.

Two weeks were spent in making an examination of many of the shell heaps and sand mounds in Lee, Collier, and Hendry counties, following which more intensive work was carried on for another two weeks. This work was greatly facilitated by the cooperation of Mr. George Hyatt of Fort Myers, at whose suggestion the work was undertaken, and of Mr. W. E. Colton, also of Fort Myers, who very generously placed at my disposal his automobile and motor boat.

The aboriginal remains of this region are of two kinds, the kitchen-middens or large heaps of shells, animal bones, and other refuse thrown out by the ancient inhabitants, and the artificial sand mounds sometimes built for burial purposes and sometimes as foundations for temples or dwellings. The sand mounds that were found on the keys, or islands, were in each case associated with extensive kitchen-middens and had served as burial places for the Indians who lived nearby. Away from the coast, however, there were other sand mounds, some entirely artificial and some merely natural ridges or hills that had been built higher. These mounds contained few or no burials and revealed



FIG. 137.—Mixed blood Seminole Indians who now live in the regions formerly occupied by the Calusa.



FIG. 138.—Shell heaps on Regla Key, southwest Florida.

but slight evidence of human occupancy. The most interesting of these inland sand mounds was a large one at Citrus Center, oval in outline, with three projecting arms 40, 100, and 300 feet long. There was no evidence that any burials had been made in it and of cultural material only a few potsherds were found. In appearance it was somewhat similar to the effigy mounds of the north and this resemblance was increased by a semicircular embankment, averaging three feet high and 10 feet wide, inclosing the greater part of the mound. Another evidence of aboriginal construction undoubtedly bearing some relation to this mound was a canal, still quite distinct, beginning less than half a mile away and extending to the westward for about a mile and a half, finally to lose itself in a swamp.

While the much larger shell heaps examined along the coast and on the keys had not in a proper sense been constructed at all, a few of them appeared to have been partially leveled off. Another work of intentional nature was a trench or canal passing through one end of a large shell heap on Captiva Island. This canal extended for a short distance beyond the shell heap, bordered by a low narrow embankment of sand which continued to the northward for a quarter of a mile, at which point it suddenly turned and formed a partial inclosure. The piling up of the shells forming this great heap and of others similar to it was, however, in no way intentional or premeditated. The heaps are true kitchen-middens, having resulted from the gradual accumulation of refuse through many years of occupancy by the Indians. This is proved by the stratified condition of the middens, which is especially noticeable in a number of places where they have been partially excavated for road material, leaving banks and sections exposed showing from top to bottom layers of ashes, burned shells and earth mixed with potsherds, animal bones, and other débris.

A short distance from the large shell heap on Captiva Island was a small sand burial mound, which, like every other mound examined, had been dug into by treasure seekers. For some reason Indian mounds seem to be the favorite digging grounds for people in search of treasure. There is always a local legend to justify the belief that treasure is buried in the vicinity. Along the Gulf Coast it is usually some well-known pirate who planted his golden horde; in other places it may be some historic Indian chief whose reputed wealth increases with the passing of the years. The result is that there is scarcely a mound in the entire Gulf region that has escaped this kind of investigation and many valuable bones and other specimens have thus been destroyed. From the size of the excavation in this Captiva burial

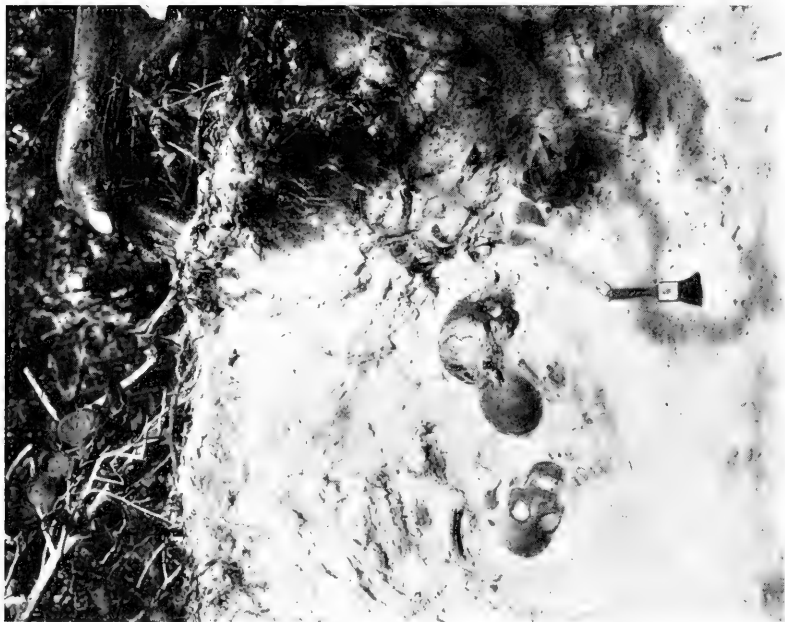


FIG. 140.—Skulls in Captiva mound. Burials in upper sand layer of mound.

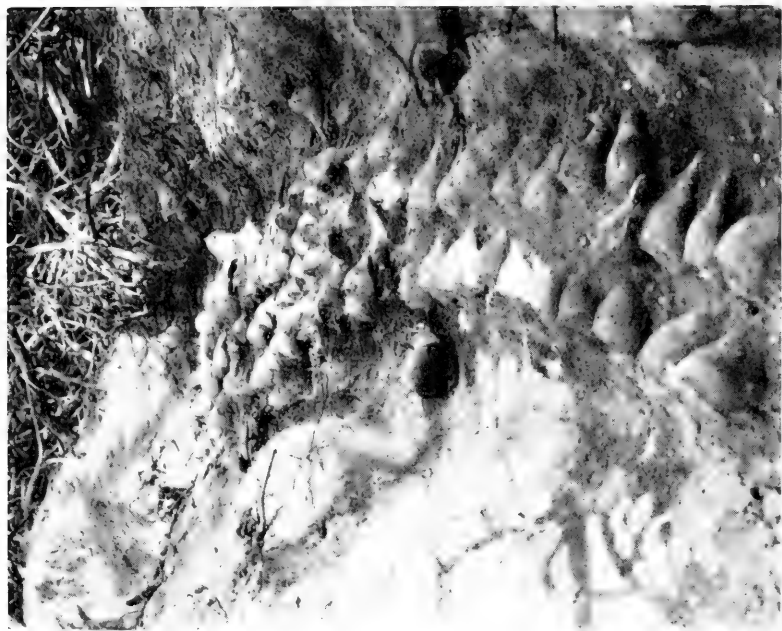


FIG. 139.—Border of conch shells around base of burial mound on Captiva Island.

mound and from the quantities of broken bones scattered about many skulls and skeletons must have been uncovered and destroyed. Fortunately, however, a large part of the mound had been left undisturbed and I was able to obtain over 70 skulls in condition to be measured.

The mound had been built only a few yards from the water's edge in a thick mangrove swamp. A pile of crushed shells and sand—beach material brought over from the opposite side of the island—had been first deposited and this, becoming saturated with the moisture of the underlying muck, had consolidated into a hard cement-like substance. The bones enclosed in this material were in very good condition but



FIG. 141.—Mr. W. E. Colton of Fort Myers examining burials in the solidified layer in the lower part of the Captiva mound.

were difficult to remove as they had to be chipped out with hammer and chisel. Above this lower layer of solidified shells and sand had been piled several feet of pure sand and in this there were other burials which were not so well preserved as those beneath. Burials were of two types: Original, with the bones in anatomical order and the limbs flexed; and secondary, with the bones disjointed, representing a deposit of loose bones that had been previously buried or kept for a time elsewhere. The secondary burials were found only in the upper sand layer. An interesting feature of the burials in this mound was that fragments of earthenware cooking pots had been carefully placed about many of the skulls.

Excavation along the edge of the mound revealed a border of large conch shells arranged in two and three rows with their upper ends facing the mound. This border was from 16 inches to three feet in width and followed the curve of the mound at its base. It may originally have extended around the mound and have been destroyed by previous digging. A somewhat similar condition was found at the opposite side of the mound where, sloping upward from the base, a space of several feet had been covered with a "pavement" of potsherds. Among these potsherds were four pieces of human occipital bone, at least three of which belonged to different skulls.

A BURIAL CAVE IN KENTUCKY

By NEIL M. JUDD,

Curator, Division of American Archeology, U. S. National Museum

The United States was functioning as a "melting-pot" for racial groups long before the Pilgrims set foot on Plymouth Rock. Diverse Indian tribes roamed the eastern woodlands, the central plains, the deserts and mountains of the West. Ethnologists estimate that more than 200 mutually unintelligible languages or dialects were spoken by the Indian population of the United States at the beginning of French and English exploration. Each of these languages represents an aboriginal group distantly, if at all, related to the others. Each group claimed a certain area as its own and defended that area from attack or occasionally increased it at the expense of neighboring peoples. Tribes contended with each other for the most desirable hunting grounds and frequently migrated far from their ancestral homes. When horses were introduced by Europeans in the sixteenth and seventeenth centuries the Indians speedily appropriated all they could capture, thus facilitating tribal movements and the activities of raiding parties.

The southeastern United States with its fertile valleys, forested mountains and temperate climate was inhabited by various tribes whose prehistoric remains have partially survived the passing centuries. Innumerable village sites and camping places are known between the Mississippi and the Atlantic coast; mounds erected as sepulchers or sanctuaries stand as monuments to their primitive builders from the Ohio to the Gulf. Archeologists seek to recover something of these native American civilizations which slowly evolved, reached the zenith of their development in pre-Columbian times and rapidly perished under the impact of European conquest. The prehistory of the United States is distinct from, yet inseparably connected with, its history since Sir Walter Raleigh attempted unsuccessfully to found the Roanoke Colony in 1584. From its establishment in 1846, the Smithsonian Institution has actively participated in researches pertaining to every phase of American prehistory.

Indian village sites are to be found in each of the 48 States but it is not yet possible always to identify the former occupants of a particular site from the ancient remains found there. Our aboriginal

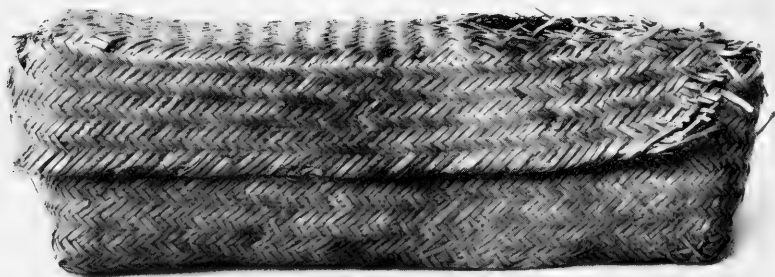


FIG. 142.—Covered basket of double weave, made of split cane, from the Wolf Creek Cave.



FIG. 143.—Headband of tanned buffalo (?) hide, with ropes attached.

predecessors left no written record, no interpretable hieroglyphic system, to guide investigators of the present. Only by painstaking exploration and the careful weighing of all recoverable data related to a given site and its associated artifacts can we hope eventually to acquire a detailed knowledge of prehistoric Indian life, tribal organizations and intertribal relationships.

During the early summer of 1928, Mr. H. Hughes of Ono, Russell County, Kentucky, kindly advised the Smithsonian Institution that certain Indian remains had shortly before been exhumed from a cave in the bluffs bordering Wolf Creek, a branch of Cumberland River. To examine these objects and the scene of their discovery, the writer proceeded to Ono in early June. Kentucky at that time was experiencing unprecedented rains. Rivers were out of bank; roads were well-nigh impassable for motors; saddle mules were stained with the red mud of mountain trails.

In company with Mr. Hughes and the three gentlemen concerned with discovery of the material in question, the writer examined the several objects and later visited the cave from which they had been removed. These artifacts included a twilled basket and enveloping cover of cane splints; fragments of other baskets or mats; a headband of tanned buckskin or buffalo hide, with fiber ropes attached; fragments of an olivella shell necklace, and lesser articles. Corn cobs, pieces of squash rind, and a single small red bean identified the former occupants of the cave as an agricultural people whose permanent dwellings were doubtless in the valley below. The habitable floor space of the cavern was extremely limited; layers of charcoal, burned earth, and decomposed vegetable matter evidenced brief, repeated occupancy.

I have called this site a cave but more correctly it is a rock shelter and a very inconsequential shelter at that. Its terraced floor, of disintegrating shale, slopes abruptly down from the harder, overlying limestone formation into an incipient creek. It rained while we were in the shelter and noisy torrents poured over the rimrock, carrying brush and stones to choke the narrow gorge. Mists from the falling flood drifted through the cave; the wet shale glistened in the half light. We may assume such occurrences have happened repeatedly since Indians camped there and boiled rabbit stews in earthen vessels, marked by a cord-wrapped paddle. The wonder remains, therefore, that basketry or any other perishable material could have survived many seasons; much less, the two or three hundred years these specimens have lasted.

According to the discoverers, a burrowing groundhog had dislodged several human toe bones, thus prompting the initial digging. Three

skeletons were exposed, two adults and an adolescent, but the crania and many of the other bones had been carried away as curios. It is probable, though not certain, that the baskets and headband were deposited with the burials—my informants had not made close observations. On the occasion of my visit the sky was so dark no photographs could be made with the kodak at hand.

The three individuals buried in the Wolf Creek cave may have been members of any one of several related tribes belonging to the Muskegean linguistic stock; they may have belonged to the Cherokee, that aggressive and culturally advanced Iroquoian people whose forefathers migrated southward from the St. Lawrence region in ancient times. The covered basket would serve as an excellent means of identification provided it were peculiar to a single tribe. Its straight sides suggest a Choctaw origin; but the Chickasaw wove similar receptacles. Almost without question it came from farther south. In his *Histoire de La Louisiane*, published in Paris in 1758, Du Pratz describes similar baskets employed by Indian women "to protect their jewels and all that contributes to ornamenting their persons. . . . It is into these that they put their earrings, bracelets, garters, beads, hair ribbons, and vermilion to paint themselves." Although Du Pratz may be suspected of pure conjecture, at least in so far as the "hair ribbons" are concerned, there can be no doubt these covered baskets were designed to protect the more precious possessions of their makers. Nomadic peoples did not trouble to acquire property.

CERTAIN EARLY PUEBLO VILLAGES IN SOUTHWESTERN COLORADO

By FRANK H. H. ROBERTS, JR.,
Archeologist, Bureau of American Ethnology

Scattered along the lower benches and bluffs above the Piedra River in southwestern Colorado are the remains of many prehistoric Indian villages belonging to the earliest Pueblo period. Several of these one-time communities were excavated by the writer during the summer of 1928, with the result that much valuable data on house-types, as well as many specimens of the material culture of the people, were obtained. The sites were first discovered by the writer in the summer of 1923 when he was conducting an archeological reconnaissance for the State Historical and Natural History Society of Colorado. The opportunity for an intensive investigation of them did not present itself, however, until the 1928 field season.

The present day investigator finds himself confronted by a rather curious paradox in the remains of these villages. Either through accident or by intent they were swept by fire and that which destroyed the houses then enables us to reconstruct them now. The dwellings were for the most part rectangular one-room domiciles of pole and adobe plaster construction. Due to the conflagration the plaster was baked to a brick-like consistency which thus far has withstood the erosive action of the centuries which must have passed since the early Pueblo peoples dwelt there. Had it not been for this firing the adobe would long ago have been melted back into the earth from which it was taken and the unprotected poles would have decayed and fallen into dust. In the majority of cases the timbers are no longer present, it is true, but their imprints are ineffaceably preserved in the hardened plaster. The walls and ceilings fell when the posts burned but in falling they went down as units, not as a jumbled mass, and it is a comparatively simple matter to determine the exact positions and manner in which they stood. In a few of the houses portions of some of the walls are still standing (fig. 145), and where such is the case bits of charred posts are to be seen encompassed by the burned clay.

Evidence secured from more than 60 houses makes possible quite definite conclusions as to their nature and the manner in which they were grouped together to make a village. Two forms of construction

were observed. The predominant one had a shallow, rectangular pit, from 12 to 18 inches deep, with a hard packed floor. The superstructure was supported on posts set in the floor a short distance from each corner. Some of the larger houses had six instead of four posts, the two additional ones being placed at about the center of each side wall. The upright posts carried stringers, which in turn supported the roof and slightly sloping side walls. The latter had a framework of small poles, placed from six to twelve inches apart, sloping from the walls of the pit to the stringers on the main posts. The wall poles were not embedded in the earth at their lower ends, as in the case of the Late Basket Maker houses,¹ but were held in position by



FIG. 144.—View of the Piedra valley taken from one of the village sites. In the middle background are two formations locally called the Chimney Rocks.

stringers supported on stones placed on the floor at the corners of the room. Cross poles overspread with leaves and brush formed the ceiling and roof. The entire wooden framework was then covered with a six- to eight-inch thickness of plaster.

The second type of house, found only in one village, showed a considerable advance over the first in that the support posts were removed from the interior of the structure and incorporated in the walls. Because of this feature there was no slant to the latter. The pit portion of this group was less pronounced, averaging between six

¹ Explorations and Field-work of the Smithsonian Institution in 1927. Smithsonian Publication No. 2957, Washington, 1928, p. 165.

and ten inches in depth. The pole and plaster method of construction continued, however.

Entrance, in most cases, seems to have been gained through small doorways in the sides of the houses. Actual doorways, with two exceptions, were not present in the ruins, but the large stones used to close them were frequently found in positions which indicated lateral openings. A few of the house remains suggested that the smoke hole in the center of the roof had also served as an entrance.

An average village consisted of from six to fifteen houses, most of which were grouped in a crescent shape—sometimes a rather long and flattened one to be sure—although occasional structures were



FIG. 145.—Portions of walls in one of the ruins excavated.

erected with apparently no regard for the general configuration. This tendency to the crescent shape obtained even where the contour of the ground upon which the village was erected did not necessitate it. The houses in general were quite close together but did not touch. One of the outstanding exceptions was the village illustrated in the plan (fig. 146), where three of them did form a single structure. This is the village which contained the second type of house, however, and which is a good example of the step taken when communities of a single structure with many rooms developed out of those consisting of many one-roomed isolated dwellings. The fullest benefits of such an advance were not possible until the sloping-sided structures had given way to straight-walled buildings.

The concave side of the village crescent was towards the east or southeast and in every instance encompassed one or more circular



FIG. 146.—Plan of one of the villages investigated.

depressions. The latter are both interesting and puzzling. There seems to be no question but that they are the remains of the pits from which

the adobe used in the construction of the houses was taken, but their usefulness did not always end there. In some cases they served in the construction of kivas or circular ceremonial rooms, while in others they seem to have functioned as reservoirs. It is impossible to tell in any given case, without hard and tedious excavation, which the depression may be.

Kivas were simple in form. After the roughly circular pit had been dug to the desired depth, it was covered with a roof supported on four posts. The native earth walls and floor were covered with a coating of plaster. There was no bench as found in later kivas; the sipapu, representing the mythical place of emergence from the earth,



FIG. 147.—Portion of a kiva. Double ventilator an unusual feature.

and fire-screen were also missing. There was a ventilator, however, at the southeast side. In the example pictured (fig. 147), it is rather curious in form, having two openings into the chamber and only a single shaft as an exterior outlet. This particular kiva had been connected to one of the houses, as shown in the plan of the village, by an underground passage which opened into it on the west side. This feature, except for the difference in orientation, seems to represent the forerunner of the closely comparable one found in the unit-pueblos of the following cultural period.

The burning of the houses not only served to preserve a record of the methods used in their construction, but also was responsible for the finding of many specimens in the ruins. Because of the haste in



FIG. 148.—Typical bowls unearthed during excavations.



FIG. 149.—Characteristic seed jar forms.



FIG. 150.—Decorated seed jars.



FIG. 151.—Various forms of pitchers found in villages.

which the structures were abandoned, practically none of the possessions of the people was removed, and consequently a large collection of pottery was secured. The vessels had been left on the floor around the walls and in the corners of the rooms. In practically every instance they were filled to the brim with charred corn, beans, or dried fruit. This suggests that disaster must have fallen upon the village not long after the harvest season, when the larders were well filled.

Pottery specimens collected include culinary vessels of the banded-neck variety; white containers with painted black designs; and red wares with painted black decoration. Forms in the painted wares include bowls (fig. 148), jars (figs. 149, 150), pitchers (fig. 151), and ladles. One rather unusual feature noted in the ceramics is the large number of seed jar forms (figs. 149, 150). They represent a much larger proportion of the total number of vessels than is generally found at such sites. Including pottery from the graves, more than 250 specimens were secured during the summer's work.

The inhabitants of the villages left various implements used in their daily life. Those made from stone include many very fine arrowheads, a few knives, grooved mauls, axes, and hoes; also polishing stones, pot-lids, and metates. The bone implements were chiefly awls and punches made from the long bones of large mammals, probably deer.

Ornaments were not plentiful and the few found do not show very great diversity in form. They include stone, shell, and bone beads, stone pendants and shell bracelets. Turquoise was practically absent. Only two small fragments of this usually popular stone were found during the entire course of the investigations.

Burials in practically all cases were in the refuse mounds of the villages. The body was placed in the contracted position and with very few exceptions was accompanied by mortuary offerings of pottery. In more than half of the burials the body had been placed on the left side with the head approximately toward the north. Where the head was in another direction the face was practically always toward the north, suggesting that a factor of some significance was attached to that point of the compass.

The refuse mounds did not occupy any definite position with respect to the village, as in later periods, but were located at the most convenient spot regardless of whether it was at the north, south, east, or west side of the community. Sometimes a mound was within the village circle.

STUDYING THE MISSION INDIANS OF CALIFORNIA AND THE TAOS OF NEW MEXICO

By J. P. HARRINGTON,

Ethnologist, Bureau of American Ethnology

A double veil has been drawn over the Mission Indians of California. They did not yield their civilization directly to the Americans, as did the Indians elsewhere in the state, but first to a Spanish culture, which persisted for only two or three generations, but strongly. At the same time the Mission area covers the picturesque shores of the southern half of California, including San Francisco, Los Angeles, and San Diego, the portion of the state which now holds the center of population and the focus of interest. To piece together the life of its red men is, therefore, doubly difficult and important.

Both field and office study by the writer in 1928 bore on the preparation of two monographic manuscripts for publication by the Bureau of American Ethnology, one on the Chumashan Mission Indians of California, the other on the Taos Indians of New Mexico. The beginning of the year found him in California engaged in field-work at Santa Barbara. In March he returned to the Bureau, and in July took the field again, proceeding first to California and then to New Mexico, returning to Washington in October and spending the remainder of the year in the elaboration of his recent and earlier notes.

The Californian work consisted of recording the knowledge of surviving Indians and of searching the Mission archives and the Bancroft Library at Berkeley for historical documents which might furnish information on the all but obliterated customs of these Indians. The historical search especially was richly rewarded by the discovery of several new manuscript sources.

As regards their ethnology, the Chumashan Indians are in a peculiarly unfortunate position. Instead of preserving their aboriginal customs up to 1850, as did most of the California Indians, they were forced to give them up considerably earlier, as their territory was included in that colonized by the Spanish in the eighteenth century, and

being on the coast they suffered more than the inland Indians, as was always the case. When finally the Americans came, in the middle of the nineteenth century, there were no ethnologists among them to write down what could still have been told by aged Indians. What the writer has accomplished is the piecing together of every scrap of information in the Spanish language, and illuminating the first-hand informational structure thus built up with the knowledge that surviving individuals of Indian descent can contribute.



FIG. 152.—Sra. Mariana Hall, Chumashan Indian informant.

The Chumashan idea of the proper figure of a man was to be built as straight as an arrow, big chested, and with body tapering from chest to toes. These Indians lived as much outdoors as did any wild animals, and they had an almost uncanny strength when aroused. The day was started and again ended with a cold bath. In the early morning a man and all his family, from babies to centenarians, headed for the arroyo and plunged in. The day was spent in hunting, fishing, gathering of vegetable food, and similar pursuits, and at sundown a Turkish bath in the *temascal* or hot house was indulged in, followed by another plunge in the cold water, and a hearty meal. After

this meal came story-telling by the firelight, or perhaps one of the various dance ceremonies, often extending far into the night.

So wholesome and tasty was the food commonly used by the Chumashans that scarcely an article was too rich to be given to young children. Acorn meal, delicious and fluffy in consistency, was the staff of life, and all other foods were regarded rather as condiments to go along with this ever-present porridge. Grass seeds were toasted to make *pinole*, which was eaten dry, stirred up in cold water, boiled like mush, or made into cakes. This second cooking made better mush than that prepared from raw meal. There were no alcoholic drinks.

The Chumashan house was shaped like the rimless hat worn by the Indian women, to employ a comparison suggested by the Indians themselves, or, to use the expression of one of the early chroniclers, "round, very roomy, large and high, shaped like a half orange." It was constructed of a framework of poles, usually willow, three or four inches in diameter at the butt end and as tall and straight as could be found. These poles were erected in a circle, about one pace apart, with their bases inserted in holes dug with a sharp stick and often scooped out with an abalone shell. The top of each pole was bent over and lashed to the top of the pole opposite giving the desired round shape to the top of the house.

Before applying the thatch, which was of *carrizo*, *tule*, or whatever was handy, small poles were attached around the uprights in the manner of horizontal hoops. These hoops were in parallel pairs, one outside the uprights and the other inside, and between the two the thatch was compressed. The base of the thatch of each tier covered the outer poles which held the tier next below in position. The lowest tier of thatching was usually applied in upright or natural position to give it greater strength where it rested on or was inserted in the ground, but successive tiers above were applied in an inverted position, the better to shed water.

Ventilation was adequately provided for in these Chumashan houses. Besides the low door, usually closed only by means of *tule* mats, many of the houses had a few side holes or windowlets, as well as a good-sized smokehole at the top of the dome. The fireplace was toward the door from the center of the house, and a fire was kept burning or banked most of the time. This fire was used for a part of the cooking, the rest being done on outdoor fires.

The houses were usually 12 to 18 feet in diameter and high enough to enable a person to stand erect in the central part. They were arranged in *rancherias*, or villages, for mutual protection, each village

containing a moderate number of houses arranged in rows, according to chance growth and convenience. The house of the chief was distinguished in no way from other houses.

In or near the *rancheria* was the cemetery. In some cases there were several ; grave groups might even be found, as a result of village growth and history, amid the very houses of the village. The cemeteries were restricted in area, the desire of a dying person being to have his bones interred with those of his ancestors. If bones were unearthed in the digging of a grave they were respectfully laid aside and carefully reburied before the new interment was completed. The graves were marked in various ways so that the cemetery was a conspicuous feature, and its location well-known to all.

The village was governed by a chief whose rule was very democratic. He prided himself upon his liberal and thoughtful judgments. Through association with those men of the tribe who had the greatest traditional knowledge, he acquired much wisdom and his words were greatly valued as counsel. The chief interfered little in the affairs of families, but represented the village in all dealings with other villages. He was looked upon as a helper rather than a ruler of the people, and so democratic was the whole scheme that women often became chiefs.

Indian life was not more lawless than life among other peoples. Everything was prescribed by custom, and the average Indian was slow-going and thoughtful, endeavoring to conduct himself in accordance with these customs. Enmities existed, of course, between individuals and especially between villages, sometimes of long standing, but these were not permitted to develop into large and useless wars. The people were frugal, although they loved games of chance and personal adornment, as have people of all times. Their lives were, of course, intensely interesting to them. Although their field of interest would seem to us a very narrow one, nevertheless it was rich enough to supply all the reactions needed for intense thought and activity.

The writer's investigations in California included the identification of Indian place names and the studying of the early maps of the region. When Juan Rodríguez Cabrillo steered his two little vessels up the Santa Barbara channel in October, 1542, the Indians who had boarded the ships started naming the pueblos along the shore, and the Spaniards contributed the idea of writing down the names that were being called out. As a result, there exist several lists of place-names many of which the writer has succeeded in definitely identifying. For

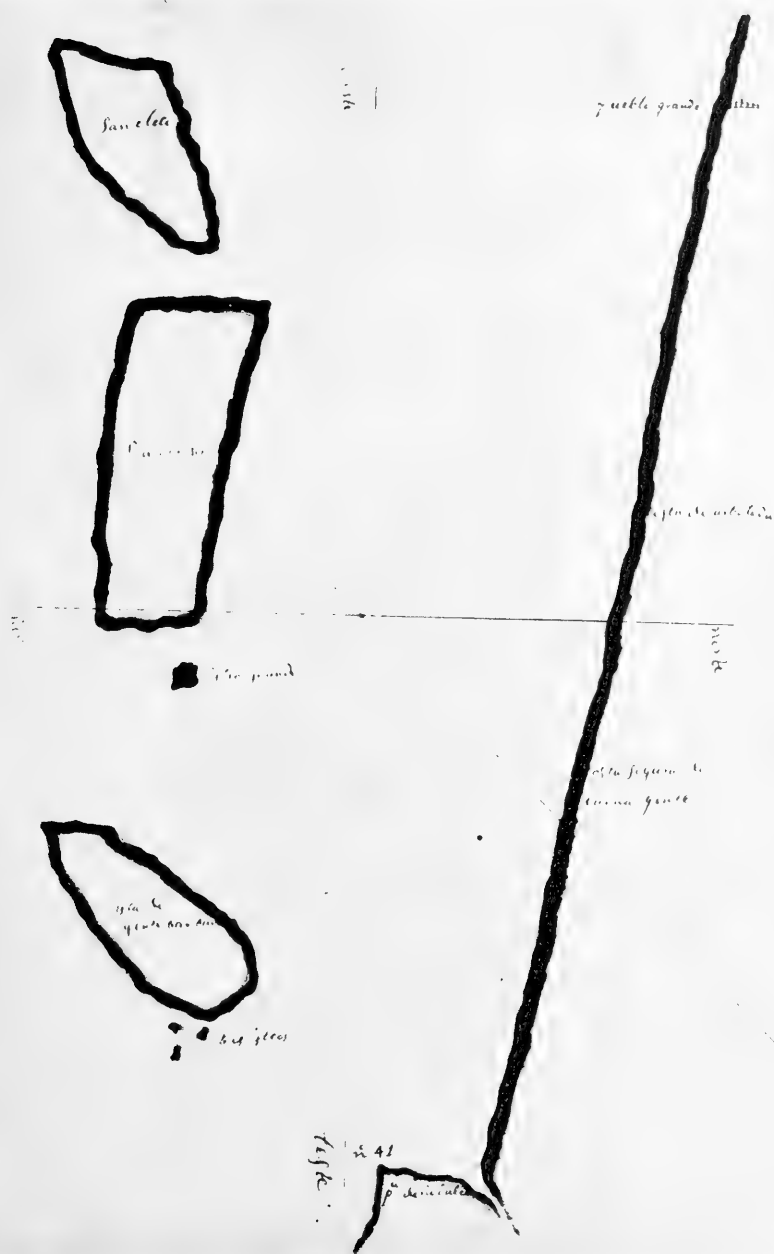


FIG. 153.—Map of the Santa Barbara Channel prepared by the Vizcaino expedition in 1602, showing a "pueblo grande" of the Indians on the mainland shore. From manuscript in the Bancroft Library.



FIG. 154.—Intact two-piece fishhook (upper figure) from the lower Klamath River, California, collected by Mr. Frank E. Gist, Cat. No. 278,488, U. S. Nat. Mus., compared with disattached parts of similar fishhooks (lower figure) excavated by Mr. Harrington in the Chumashan area.

the success of these studies, he is greatly indebted to Professor H. E. Bolton and to Mr. F. W. Hodge.

A study was also made of the earliest detailed maps of the California coast, those prepared by Sebastián Vizcaíno's cartographer in 1601-1603. The map of this series representing the eastern and central section of the Santa Barbara Channel is reproduced here as figure 153. A "pueblo grande" or large town of the Indians on the mainland shore will be seen indicated at the upper right-hand corner of the map. Practically every feature on the Vizcaíno maps has been definitely identified and explained. A comparative study has been made of the copies of these maps in the Archivo General de Indias, Sevilla, 60-4-37; in the Dirección de Hidrografía, Madrid, bol. Navarrete, tomo 19, no. 9; in Lowry, Spanish Settlements in the United States, California Transcripts, Library of Congress; and in the Bancroft Library, University of California.

Numerous disconnected parts of two-piece bone fishhooks have been found by the writer in his California investigations and such fragments had already been described by the Rev. Stephen Bowers in the first volume of *Science* in 1883. No such fishhook had ever been found intact, however, until this year, when in looking over collections in the National Museum, the writer found an entire specimen (see fig. 154). It was collected by Mr. Frank E. Gist, of Weitchpec, California, years ago; it is in perfect condition with wrapping, pitching, and attached cord, and is precisely the article known from the Santa Barbara channel graves.

The work at Taos, New Mexico, consisted of a complete interpretation of the life and customs of the Taos Indians, and the writer had the privilege of witnessing the famous San Gerónimo Day dance. The distinctive costumes still worn by the Taos men are shown in figure 155. Nowhere among our United States Indians are old customs more faithfully followed at the present time than in this picturesque corner of the southern Rocky Mountains. A large map of the region was prepared, with the help of Mr. L. Pascual Martinez. One of the sacred places of the Indians, Blue Lake, is shown in figure 156. A Taos dictionary of several thousand words was also prepared, containing, among other features, Taos bird identifications by Professor Vernon Bailey and Mrs. Florence Merriam Bailey.

The Pueblo of Taos, situated on both sides of a beautiful and strong-flowing eastern tributary creek of the Rio Grande at an altitude of 6,500 feet, is in many respects the most remarkable of the pueblos. It has the distinction of lying furthest north of all the Indian pueblos



FIG. 155.—The Governor of Taos, 1927, illustrating two ways of wearing the blanket. (Photographs by Fred Clark.)



FIG. 156.—Blue Lake in the Santa Fe Range, one of the most sacred places of the Taos Indians.

of the old Spanish province of New Mexico. Moreover, it is stated in the reports of the Coronado Expedition, 1543, to have been the largest of the pueblos and to have had the finest estufas. Again, it has played the most prominent part of all pueblos in New Mexico history. It is the pueblo that has the tallest people and those of most comely appearance. Its people are the proudest of the Pueblos and have most nobly preserved their American racial customs against all encroachments of foreign firearms, firewater, debauchery, and Mexican and American custom. The history of Taos presents a brilliant pageantry. Its social organization remains as in the days of Coronado. Its religious life is filled with beautiful and true symbolism derived from the gorgeous universe in which the people dwell. The language is smooth and flexible and its study gives one great respect for the superior mentality of the Taos people.

'Iählaphäiba, "Up at the Red-looking Willows," is what the Taos Indians themselves call Taos. The pueblo is built at a big patch of Sandbar Willow, *Salix exigua* Nutt., which extends around and far south from the village. The stems of this species are red, giving a red appearance to the trees; hence the name. The gall-midges, resembling buds, with which these trees are laden are *Rhabdophaga strobiloides* Osten-Sacken. The modern town of Taos, earlier called Fernandez de Taos, three miles south of the pueblo, is to the Indians P'axwiänu-wa'aga, "Down at the Lake of Night." Pueblo Peak, the sacred dome mountain northeast of the pueblo, is Maxwaluna, "The High One," while far to the west, in the hill region beyond the Rio Grande, stands up a little two-peak mountain, Tuxwat'ahlöathutha, "Coyote-Ears Pile." The names of places all about are ancient and fascinating.

Taos is called in the reports of the Coronado Expedition "Yuraba," "Uraba," and "Braba." This also has been unraveled and Braba is pointed out by the writer for the first time to be for Vraba, *i. e.*, Uraba, and this in turn for Yuraba, which Hodge has already identified as the Pecos name for Taos.

THE CULTURE OF THE INDIANS OF EASTERN CANADA

By J. N. B. HEWITT,

Ethnologist, Bureau of American Ethnology

In the provinces of Quebec and Ontario, Canada, there dwell remnants of the tribes of the Six Nations of the Iroquois and of the Hurons, and also small bands of the Chippewa and of the Delawares of the Algonquian stock, whose myths, social organizations, religious institutions, and languages offer a field for the intensive study of the culture of these native Indians. For a number of years I have carried on researches in these subjects among these tribes.

During the 1928 field season, between May 18 and June 30, I visited four widely separated Indian reservations in carrying on these studies, namely, those at Garden River near Sault Ste. Marie, Ontario, Canada, at La Jeune Lorette, near Quebec, P. Q., at Caughnawaga, near Montreal, P. Q., and on the Grand River Grant, near Brantford, Ontario, Canada.

At Garden River, with the assistance of Mr. George Gabaoosa, a Chippewa Indian, I revised and cleared up some moot points occurring in the translation and interpretation of a number of Chippewa myths of origin concerning Nanabozho and his grandmother, which had been recorded in previous years from Mr. John L. Miscogoon of Arbre Croche, Michigan, and from Mr. Gabaoosa.

At La Jeune Lorette I recorded a very satisfactory vocabulary of Huron words, which showed the blending of at least two dialects.

At Caughnawaga, about nine miles above Montreal and directly across the St. Lawrence river from La Chine, I renewed my quest for any definite knowledge of the institutions of the League of the Iroquois on the part of the 17th century emigrants from the Mohawk and other Iroquois tribes of the Colony of New York now living there. It was found that the Caughnawaga Indians have practically no trustworthy knowledge of the structure and the institutions of the ancient League. They have forgotten this knowledge so completely that, probably unwittingly, they have confused the ethical principles of civil government propounded by the founders of the League with the religious teachings of the Seneca prophet, Handsome Lake. This confusion of two distinct forms of discipline, in such wise that they have come to be regarded as essentially one and the same, has unfortunately resulted

in a singular religious antagonism to them in the minds of these Christian converts. The teachings of Deganawida and Handsome Lake, thus erroneously coupled, were lightly repudiated as the futile expression of rank heathenism. But these perverted views of the institutions of the League are most tenaciously held, the tenacity varying usually in inverse ratio to the probability of their truth. The Indians boast several clans which could not have been in existence at



FIG. 157.—Chief Prudent Sioui, a Huron (Iroquoian) of La Jeune Lorette, near Quebec, Canada.

the date of the founding of the League, although they maintain that these units belong to the earliest League organization. Such are the Onondaga (*roti'sěnnāke* 'te') and the Oneida (*rotiněnyote* 'roñno') clans. So unreal was the basis for these two units that the *calumet* was made the clan blazon of the Onondaga, when in fact it belongs to the Oneida tribe. I here differentiate clan from tribe.

On the Grand River Grant, among the Six Nations of the Iroquois dwelling there, I devoted my researches to the translation and elucidation of a number of brief myths, recorded in former years, relating

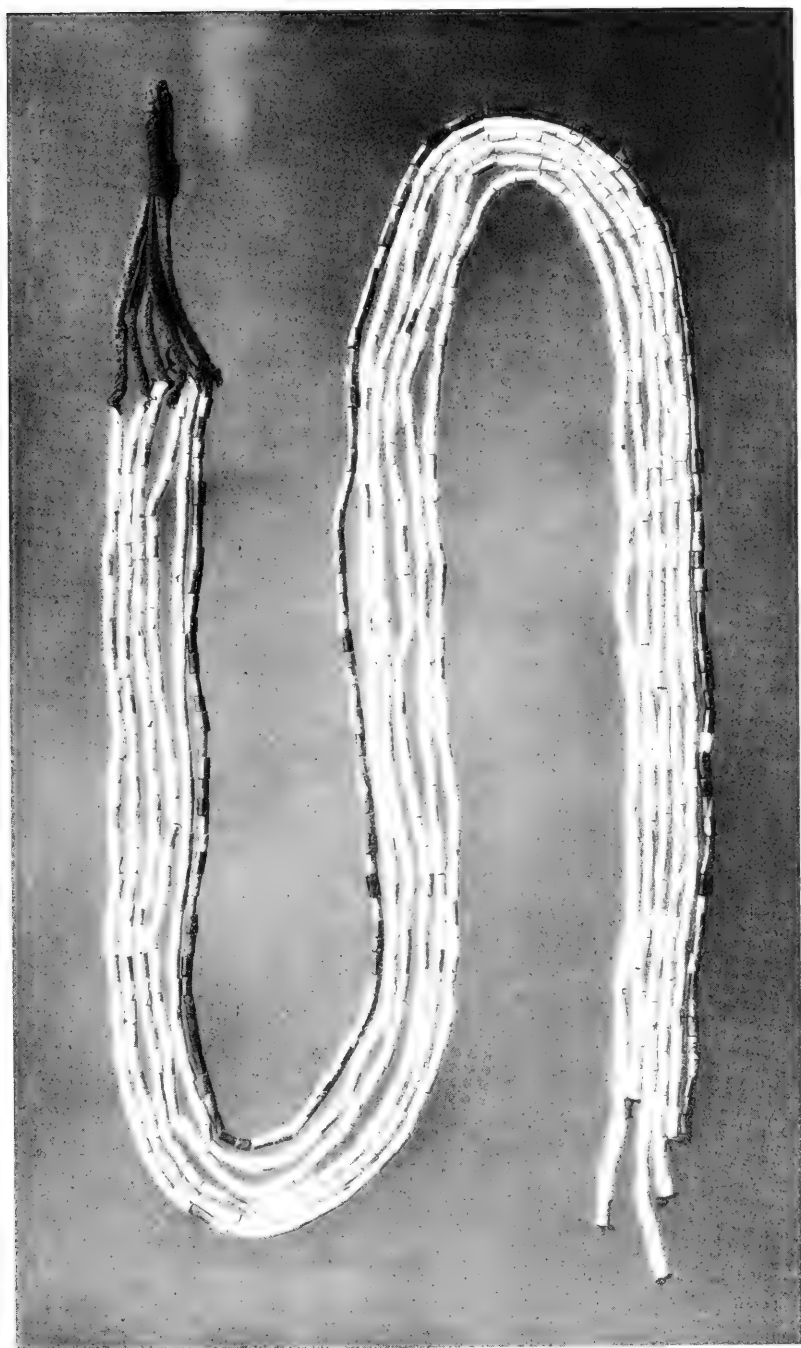


FIG. 158.—The Mace of the Federal Council of the League of the Iroquois.

to the Wind or Disease Gods. Owing to the efficient aid of Chief John Buck, a Tutelo-Onondaga mixed-blood, this work was very successful. These Disease Gods are Man-Beings, the offspring of the exuberant creative faculty of the human mind. They are represented by means of likenesses in wood or corn-husks, which are universally miscalled masks and even falsefaces. Both these designations convey ideas absolutely contrary to the native Indian conception of these likenesses. The purpose of the likenesses in wood and corn-husks is not to conceal or to hide—to mask, so to speak—anything or person, but to represent directly the Man-Being in mind. Furthermore, it is learned that the ugly and misshapen features of these Disease Gods



FIG. 159.—Mr. and Mrs. John Buck. Mr. Buck is a chief of the Tutelo (Siouan) remnant among the Six Nations of Ontario, Canada.

are the result of their defeat and subjection by the Life God or Master of Life, and are therefore the everlasting token of such subjection.

Through a number of fortunate circumstances I was able at this time to secure what in use and purpose was the Mace of the Great Federal Council of the League of the Iroquois; it consists of five white strings and one purple string of wampum, each of which is three feet in length. The five white strings represented the right and authority of the original Five Iroquois tribes, and the purple string of wampum that of all other tribes adopted into the jurisdiction of the League, legally to hold and to participate in the sessions of the Federal Council. So in opening and in closing the sessions of this Council the Firekeeper or the Speaker of the Council held suspended from his hand this symbol of delegated authority.

ALGONQUIAN INDIAN TRIBES OF OKLAHOMA AND IOWA

By TRUMAN MICHELSON,
Ethnologist, Bureau of American Ethnology

To renew my researches among Algonquian tribes of Oklahoma and Iowa, I left Washington July 5, making my first headquarters at Shawnee and McCloud, Oklahoma, where field-work among the so-called Sauk and Fox of the Mississippi and the Kickapoo may be advantageously pursued. It may be explained that the name "Sauk and Fox of the Mississippi" is a legal one, and does not correspond to the ethnological facts, for in language they are Sauks, and the social organization is Sauk, not Fox. It is true that there are some Foxes incorporated with this group, but, with the exception of a few recent comers, they all speak Sauk. The Sauk of Oklahoma to-day are rapidly becoming civilized; scarcely a single aboriginal dwelling, bark-house, or wickiup (wigwam) is to be seen. Native religion, however, still persists with great vigor. Among the scientific results obtained by the expedition may be mentioned the fact that the clan (or, more technically, gens, as the Sauk are organized in exogamic totemic groups with male descent) designated as "Ringed Perch" by Forsyth in 1827, despite the recent claim that it is only a personal name, is in reality a clan as I had previously surmised from other documentary evidence and from field-work among the Foxes (Meskwakies) of Iowa (see the 40th Ann. Rept. Bur. Amer. Ethn., pp. 501, 502). Nevertheless the evidence is only too plain that Sauk social organization at the present time is but little understood, and that a long period of intensive work will be needed to unravel it. It should be added that the Sauk have a general term for the Potawatomi, another for the Citizen Potawatomi of Oklahoma, and a third for the Prairie Potawatomi of Kansas. This last corresponds to the designation the Prairie Potawatomi give themselves according to Skinner; see also below in my remarks on the Kickapoo of Oklahoma. Therefore the contention that anciently there were two sets of "Mascoutens," as I have long maintained, is again borne out. Finally it may be noted that in phonology the Sauk language agrees in some important respects



FIG. 161.—A Southern Cheyenne, The keeper of the famous "Medicine-Arrows." (Photograph by Michelson, 1910.)



FIG. 160.—George Black Cloud, a Fox, showing a string-figure known as "bridge." (Photograph by Michelson.)

with Fox as opposed to Kickapoo. It will be recalled that all three are very close to each other; broadly speaking Fox and Kickapoo are more archaic than Sauk.

The Kickapoo of Oklahoma to-day present a picture very different from that of 1911 when I first worked among them. Practically all of the young people have a fair knowledge of English, and citizen-clothing is universally worn, though I did have the good fortune to see a few men, who had come from Mexico, with buck-skin leggings.



FIG. 162.—Mexican Kickapoo of Oklahoma. In 1911 the Mexican Kickapoo were still a comparatively primitive people, but they are now rapidly adopting civilized customs.

Native ethnology, however, has survived with great vigor, and there are still many dwellings built on aboriginal lines. In the "bark-house" planks are substituted for the bark, but the planks are perpendicular—not horizontal as among the Foxes of Iowa. The general scheme of Kickapoo sociology is understood, but details are lacking as yet. With all their progressiveness in many ways, they are tenaciously secretive regarding their ancient civilization. It may be noted that children are still named at special festivals, as was formerly the case among the Foxes of Iowa. The Kickapoo language in some respects (in vocalism,



FIG. 164.—Mrs. Morgan, an aged Fox, recently deceased. When Harry Davenport died in the summer of 1928, Mrs. Joseph Tesson was the last survivor of the really old Foxes.



FIG. 163.—Leo Walker, an Oklahoman Sauk. (Photograph by Michelson, 1911.)

technically) agrees with Ojibwa and Cree as opposed to Sauk and Fox. Although Kickapoo may therefore be presumed to be more archaic than Sauk and Fox in certain particulars, yet as a whole, Fox is more archaic. There is a special term for a certain branch of the Potawatomi, which corresponds to "Mascoutens."

Towards the close of July, I made my headquarters at the U. S. Indian school at Concho, where for a short time I devoted most of my attention to Southern Arapaho language, being fortunate enough to secure the services of Cleaver Warden, who has worked with other scientists previously (Dorsey, Mooney, Kroeber). Southern Arapaho does not differ markedly from Northern Arapaho. As I have stated on more than one occasion, Arapaho is a very divergent Algonquian language. The phonetic shifts which occur are highly complicated, and the quality of the vowels surrounding or adjacent to consonants must ever be kept in mind when formulating these shifts. Owing to the complex character of the shifts, words which superficially do not seem the least Algonquian can nevertheless be shown to be such. Although at present only a small percentage of the total vocabulary of Arapaho can be shown to be Algonquian, it is possible that further discovery of phonetic shifts will show a larger proportion of the vocabulary to be such. In grammar Arapaho is fundamentally Algonquian, even though some categories apparently have broken down. It must be admitted that certain traits (particularly the order of words) are distinctly unlike those of other Algonquian languages. At the same time, I was able to discover some Algonquian features which have hitherto been overlooked. Though spending most of my time on linguistics, some important data on the military societies was acquired. Incidentally, I heard some Southern Cheyenne spoken. It apparently is not as divergent as Arapaho.

Shortly after the first week in August I went to Tama, Iowa, to renew my work among the Foxes, whose native name when translated into English means "Red Earths." Externally little change had taken place since the previous season. It may be noted that making jewelry, toy canoes, and baskets more than ever before supplies these Indians with good incomes. Much of the basketry is modeled after Winnebago styles, though the Foxes also have styles of their own. While at Tama I restored a long text (written in the current syllabic script) on the Wāpanōwiweni, and obtained some grammatical notes on it. Some additional texts on some festivals of the War Chiefs gens, etc., and some translations were obtained, as well as important new data on Fox sociology. The general ritualized character of Fox social

organization is abundantly clear. It is remarkable that these people whose external life does not differ very strikingly from that of the whites should have preserved such a wealth of lore and ceremonials. Unlike many of our Indian tribes the Foxes not only remember their ancient customs but still practice them.

MUSIC OF THE WINNEBAGO AND MENOMINEE INDIANS OF WISCONSIN

By FRANCES DENSMORE,

Collaborator, Bureau of American Ethnology

For many years the writer has recorded and studied the music of the American Indians, and during August and September, 1928, this study was continued among the Winnebago and Menominee of Wisconsin. One visit to each of these tribes had been made in previous years, and the purpose of this trip was to witness certain dances, to add details to the descriptions already obtained, and to record more songs of certain classes. In the course of the work, about 1,900 miles were covered by automobile.

The first tribe visited was the Winnebago, who were holding a large dance near Black River Falls. Former acquaintance with this conservative group of Winnebago was of assistance, and the writer remained in the camp daily from morning until late evening. The camp circle consisted of about 50 tents, the Indians having come from a wide radius of country. In the middle of the circle was a structure similar to that used by the Menominee and shown in figure 168. The drum was like the Dream Dance drum of the Menominee; 15 men beat upon it, seated closely on the square bench around it. The men in costume numbered 25, and about 35 women and children joined in the dances, many wearing elaborate Indian costumes gay with beads and silk appliqué. The dancing, which continued three days, included a portion of the green corn dance as well as war and social dances. Both men and women took part in many of these dances, the women forming a circle next the drum and the men dancing in a larger circle around them.

Many interesting incidents were observed in the camp when the dancing was not in progress. For example, the men in charge of the drum were seen warming it beside a cooking fire in the daytime and a camp fire at night, and on sunny days they carefully tilted the drum against a bush so that the warmth of the sun would tighten the head to the desired tension. In a tent, one morning, a group of men and women were playing the "plate game," disks (or dice) being tossed

upward in a shallow bowl and the score counted by the sides of the disks which fell uppermost. The manner of play and of counting the score were noted down and, at a later time, the Winnebago tradition concerning the origin of the game was related by Thundercloud (fig. 115, p. 191, text). There are four women in the sky and they are playing this game. There are eight stars in a ring and they dropped



FIG. 115.—Thundercloud, a Winnebago, Iowa, near Black River Falls, Wisconsin.

down and made the disk. "You can see the wooden disk in the sky every night." The ring of stars and the bowl were identified as the "Northern cross," a constellation clearly seen in this region. Thundercloud recited the song of the game-origin and said: "The sound of the dice is in the song."

Twice during these dances a horse was given away by a woman. According to the custom of the Indians she held a switch in her hand



FIG. 166.—Islands below dells of Wolf River, Menominee reservation, Wisconsin.



FIG. 167.—Log house in pine woods at Keshena, Menominee reservation.
(Photograph by Miss Densmore.)

when making the presentation speech and then handed it to the recipient of her gift. This represented the whip, and the horse was delivered to the new owner at a subsequent time. Only one song is used when the stick representing a horse is given away. This was recorded by Henry Thunder and has the words "He (or she) is brave enough to give away a horse."

Leaving the Winnebago at the conclusion of the dance, the writer went to the Menominee reservation but returned to the Winnebago in September and recorded numerous songs. She visited a wide region in the vicinity of Tomah, Wisconsin, but found that the Indians were absent in the cranberry marshes; accordingly she went each day to Millston, where a member of the Thunder clan maintains a basket-making camp. Songs were recorded there and at a similar camp north of Black River Falls. The mild weather made it possible to hold conferences in the open air. The recording instrument was a dictaphone, which was placed on a bench or on the running board of the car and was operated by a storage battery within the car. This method has not been used heretofore but proved satisfactory.

A series of old war songs was recorded by Thundercloud, beginning with the song at the dog feast before the departure of a war party and continuing to their return with scalps of the enemy. These songs are connected with a war bundle and are sung at the Winter Feast. A description of the scalp dance included the custom of carrying the scalps, fastened to poles, in a procession around the outside of a long wigwam similar to the Medicine Lodge. After a similar procession inside the wigwam, the poles bearing the scalps were stuck in the ground east of the war bundle, and the drum and gourd rattles were placed beside them. A similar performance was enacted when the Winnebago young men returned from service in the World War, except for the absence of the scalps. A new dance was also invented to celebrate their victory. Several songs composed by Winnebago soldiers when in France were added to those already obtained. One such song was addressed to a young Indian who did not enlist and contained the words, "Our beloved flag went across the ocean and came back. Are you really glad to see it back again?"

Other recorded songs included those of the "first hunting," in which the Indian asks the chief of the deer for meat so that his people may have food, and a second song of thanks for the meat. An interesting moccasin-game song contained the words, "Why do they call me fish-winner?" In explanation of the latter it was said that in old times when the people had nothing else to wager they used fish in



FIG. 168.—Dance structure at Zoar, Menominee reservation, in which Dream Dance was held. (Photograph by Miss Densmore.)



FIG. 169.—Women singers at Menominee Dream Dance. (Photograph by Miss Densmore.)

betting on the results of the moccasin game. The words of such songs indicate their descent from a distant past. The work among the Winnebago also included the recording of green corn dance songs, several legends with their songs, and the songs of social dances.

From Black River Falls, in August, the writer went to Keshena on the Menominee reservation, a region of picturesque water courses and heavy pine woods (figs. 166 and 167). The first portion of her time was devoted to reading her manuscript on Menominee music to David Amob, a member of the tribe who speaks English and is particularly conversant with the old customs. Many interesting additions to the material were made at this time, and songs were recorded by Amob. Legends concerning Manabus recorded by Amob are among the secret legends of the Medicine Lodge.

A Fair is held annually by the Menominee, and one of its attractions is the Indian dancing. This Fair continued five days, affording a valuable opportunity to see dances which are seldom given at the present time. Most interesting among these were the dances in which the actions of birds and animals were imitated. Concerning one dance it was said that a man saw a frog running on top of the water, then diving and coming up farther along. The frog sang, and the man learned his song. Later the man invented the dance in which this song was sung at the drum while the dancers hopped like frogs. Another dance song came from a fish and contained the words (freely translated) "His mouth is open." Other songs were received from the rabbit, partridge, owl, and crawfish, the actions of each creature being imitated by the dancers. Only two or three old men knew the songs for these dances and said that, so far as they remembered, the dances had been used only for entertainment. The dancing at the Fair included war and social dances, and the Tobacco Dance, which is an acrobatic dance of unusual interest. Additional songs and details of this dance were obtained from the singers after the conclusion of the Fair.

During the latter portion of her stay among the Menominee, the writer witnessed a Dream Dance at Zoar, a native village about 20 miles north of Keshena. The Dream Dance is a ceremony in which a large drum is given by one tribe to another, this drum being the symbol of what is called the "drum religion." At this time a drum was given to the Menominee by the Lac du Flambeau Chippewa. The ceremony continued four days and was watched with close attention, on one day the writer remaining beside the dance enclosure for about ten hours. The same ceremony was witnessed in 1910, at the same



FIG. 170.—Menominee and Chippewa singers with hand drums, Dream Dance at Zoar, Wisconsin. (Photograph by Miss Densmore.)



FIG. 171.—Group of mourners at a rite for their benefit, Menominee Dream Dance. (Photograph by Miss Densmore.)

location, in connection with a study of Chippewa music and, by a further coincidence, the donor of the drum on both occasions was White Feather of Lac du Flambeau. This afforded an opportunity for comparing the two performances, and it was noted that the ceremony of 1928 was given by a smaller number of people but with no diminution of fervor and apparent sincerity. The writer found former acquaintances among the Chippewa who assisted her in following the details of the ceremony. Assistance was also received from the Menominee, especially from Rattlesnake, who acted as manager of the event.

The drum is said to be the property of the tribe but is in charge of one man, known as the "drum owner." The Menominee recipient of the drum was John P. Matchokemon. It will be his duty to keep tobacco beside the drum and to hold frequent meetings at which the ethical teachings of the "drum religion" are set forth.

The ceremony was held in the enclosure shown in figure 168, a space for the drum being in the center. In this dance the women sing with the men, holding their hands or shawls over their mouths (fig. 169). They sit in a circle behind the men at the drum. This is a custom of the Sioux, from whom the drum is said to have been received.

On the second day of the gathering an interesting rite was performed for "restoring the mourners," this terminating the period of mourning by those who had lost relatives during the preceding year. The mourners were seated at the left of the drum (fig. 171). Each had an attendant and, while the proper songs were sung, the faces of the mourners were washed, their hair was smoothly combed and they were arrayed in fresh raiment. Their faces were painted with red paint, ribbons were tied on the hair of the women and bead chains were hung about their necks. Gifts of clothing and blankets were piled in front of them and later they were led somewhat reluctantly to seats near the drum. In the midst of so much attention they sat with downcast eyes, but after this rite they were not expected to show signs of grief.

On the third day the Chippewa were engaged in teaching the ceremonial songs to the Menominee and small drums were used, only a few persons dancing (fig. 170).

On the fourth and last day the large drum was taken from the house of its new custodian (fig. 172) and placed on the ground a short distance in front of his door. There the final songs were sung by both tribes. The writer heard the songs and saw the drum carried



FIG. 172.—Home of John P. Matchokemon, custodian of drum given to the Menominee by the Chippewa at Dream Dance, Zoar, Wisconsin. (Photograph by Miss Densmore.)



FIG. 173.—Menominee burying-ground. Menominee reservation, Wisconsin.

back into the house. Then followed the farewells to the Chippewa, who were camped along a ridge at the right of the house. Tents were taken down, horses were harnessed and equipment packed in wagons or cars, and in a short time the guests had departed.

Beyond the ridge on which this house stands is a Menominee burying ground (fig. 173), which shows the preservation of old customs in this interesting tribe.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1929



(PUBLICATION 3060)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION

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PREFACE

Much of our present knowledge of the races of man, of animal and plant life, and of the face of the earth itself, has come directly from the field notes and collections of scientific men and explorers who have gone out to the far corners of the earth with definite problems to solve. It is a paradox of the search for knowledge that the more is learned, the more unforeseen problems present themselves for study, so that the pursuit of knowledge in the field and in the laboratory goes on with an ever-widening front. The Smithsonian endeavors to carry its sector in this advance through researches in the laboratories at the Institution and through field expeditions in the sciences of geology, biology, anthropology, and astrophysics.

The present pamphlet presents some of the researches upon which the Smithsonian is working and some of the interesting aspects of the expeditions which sought during 1929 to advance these researches. The Institution is able from its income to pay the expenses of but a very few expeditions each year; for the rest it is indebted to its friends and to various other institutions whose cooperation in various ways has made them possible.

W. P. TRUE,
Editor, Smithsonian Institution.



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OBSERVING THE ENERGY OF SUN-RAYS¹

By C. G. ABBOT,

*Secretary of the Smithsonian Institution, and Director of the
Smithsonian Astrophysical Observatory*

All terrestrial life depends on sun-rays. The chemical processes in plants which are the fundamental basis of all foods; the temperature and rainfall which constitute essential life-conditions; the supplies of coal, oil and waterpower from which manufacturing, transportation, and lighting receive their energy; as well as the beauties of earth and sky, are all the gifts of solar radiation. Such were the considerations which led the third Secretary of the Smithsonian Institution, Dr. Samuel P. Langley, to establish the Astrophysical Observatory for the study of sun-rays, their intensity, their quality, the transparency of the atmosphere to them, their transformation into heat, and the important effects in the atmosphere and on the earth's surface to which they give rise.

Beginning in 1890, in temporary quarters at Washington, the first investigations were devoted to mapping the lines and bands of solar and terrestrial atmospheric absorption of the invisible rays beyond the red end of the colored spectrum. We then turned, in 1902, to the measurement of what is called the "solar constant of radiation," which is the measure of the intensity of solar energy available to warm the earth. Some results of 1903 aroused the suspicion that this quantity is not really constant. If so, its variations must affect the climates and weather of the whole world. As the smoke and dust of Washington raised difficulties for this research, in 1905 the observing was transferred to Mount Wilson in California, where the work of making daily observations of the "solar constant" continued, but only in summer and autumn months, until 1920. Many associated studies relating to the transparency of the atmosphere, the brightness and color of the sky by day and by night, the distribution of brightness over the sun's disk in all colors were also made on Mount Wilson. As evidences of solar variation appeared, expeditions were made to Mount Whitney in California and Bassour in Algeria, to test whether the result depended on atmospheric conditions.

In 1918, in order to obtain daily measures of solar variation in winter as well as summer, and where clouds and dust would be of

¹ All photographs in this article are reproduced by courtesy of the National Geographic Society.

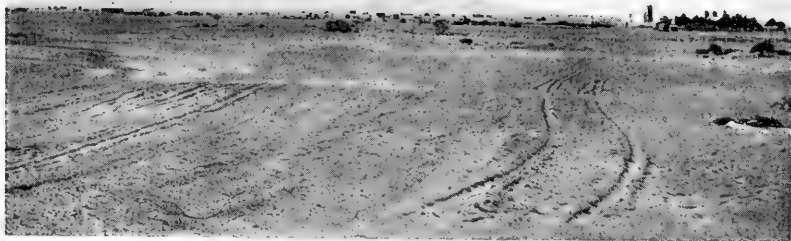


FIG. 1.—Looking over the Hottentot town of Berseba, the only town within 7 miles, towards Mt. Brukkaros, which rises 2,000 feet above the plain.



FIG. 2.—The observer's dwelling on Mt. Brukkaros. The mountain top is practically devoid of vegetation, and water for all purposes is brought up from a water-hole about a mile away.

little hindrance, a station was established near Calama in the nitrate desert of Chile. Here the work (now conducted nearby on Mount Montezuma at 9,000 feet elevation) has been continued through nearly 80 per cent of the days ever since its establishment. This long Chilean series of solar-radiation observations has no counterpart in the world for length and continuity of observation. It confirms beyond question the variation of the sun. As the accuracy of the work has grown, the range of variation formerly supposed solar has indeed diminished, but still periodic changes of 11 years, 2 years, 14 and 11 months are clearly shown, and irregular, short-interval changes also appear.

Mr. H. H. Clayton, formerly chief forecaster of Argentina, has made a very extensive study of the changes in weather which may be associated with these solar changes. He believes himself to have established certain relations between weather and solar variation which are capable of being used for forecasting purposes, and he now conducts a private forecasting bureau.

In 1920 another station for all the year was occupied on Mount Harqua Hala in Arizona. In 1925 this station was removed to Table Mountain in California, where the sun has been observed on 80 per cent of days until now. The National Geographic Society, appreciating the world-wide interest and importance of measuring the life-supporting solar rays, financed in 1925 the selection, equipment, and continued occupation of a new station on Mount Brukkaros in South West Africa. This station is still cooperating with the Smithsonian stations in North and South America for the study of the variability of the sun.

It has become possible, as a result of the long study and experience with this problem, to measure the sun's radiation as it is outside our atmosphere in free space with an accuracy better than half of one per cent. Thus we are able to detect variations of one per cent and less in the amount of solar energy available to warm the earth. The values recently obtained range from 1.910 to 1.960 calories per square centimeter per minute.

During the past year the three stations have cooperated as before. Messrs. Hoover and Greeley, having been three years in South West Africa, have been relieved by Messrs. Sordahl and Froiland. Mr. Butler has relieved Mr. Baughman in Chile, and Mr. Greeley is returning to Table Mountain in California. By the generous assistance of Mr. Roebing the continuance of the station in South West Africa has been assured for the years 1930 and 1931, after which it



FIG. 3.—Hauling supplies with a 16-mule team from the railway to the observatory on Mt. Brukkaros, a distance of 60 miles.



FIG. 4.—Automobiling through the Great Fish River after a rain. Usually the river bed is deep dry sand.

is hoped that the two observing stations in North and South America will suffice to continue a sufficient record of solar variation.

During the latter part of the year 1928 the apparatus at Mount Montezuma got so much out of order as to prejudice the observations. Aided by a generous grant from Mr. Roebbling it was possible to send Mr. L. B. Aldrich, who has had much experience in building and adjusting delicate parts of the outfit, to put all in order. He remained in Chile during part of January and February, 1929, rebuilt the delicate galvanometer completely, and readjusted the entire outfit. The last similar overhauling was made by Aldrich in 1925, and prior to that by Dr. Abbot in 1921. When it is considered that the bolometric outfit used, which includes the galvanometer just mentioned, is able to observe changes of temperature in the spectrum as small as one one-millionth of a degree, it may be thought remarkable that trouble develops so infrequently.

The following excerpts from recent letters of the directors of the three field stations present some of the interesting aspects of the year's work.

Mr. Sordahl writes in November, 1929, from the station on Mt. Brukkaros, South West Africa:

We are now quite well located in our new surroundings and have some time to look around and see what kind of neighbors we have. The Karoo was covered with flowers in bloom as there had been a drenching rain in the preceding week, the first in several years. The people certainly are very friendly and Mrs. Dryden is almost like a mother to all of us.

The Hottentots accuse your party, in particular yourself, for the long drought at the present time, but indications are that we will have a wet year, the old settlers maintain.

Mr. Hoover will undoubtedly tell you what the present view is regarding the origin of the mountain as a volcano. Recently, after being told of the fact some time ago, I have found that there is handed down a legend, one might call it, among the natives that they saw smoke issuing from the crater about two hundred years ago, but the evidence is too questionable to have much weight among the people here. One item which may be of interest in case it is not already known, is the origin or the meaning of the name Brukkaros, which I have been told means "the broken belt" as it appears from Berseba—a complete circle except for the pass by our waterhole.

Leopards have been getting quite active about five miles southwest of us and are killing cattle for the natives, and one boy was recently killed. We have two 30-30 rifles with which to welcome them, so they will probably avoid this place. We are rather anticipating hunting season as the springbok are quite numerous and should be interesting to get. We were down swimming in the Fish River and found our region is not so destitute for recreation. Yesterday we bagged a wild duck and look forward to a feast if Margaret is in the similar spirit. She

is quite occupied with collecting as there is a large variety of specimens here. At the present time we are constructing a tennis court on the plateau to the west of the station, on spare time. It is only about a ten-minute walk from the house over an almost level trail.

The sky has been very good thus far in November, although usually cloudy in the afternoon which is not as good for long methods which can only be obtained at that part of the day. We are taking all the long methods possible as Mr. Hoover stated that only about 50 or 60 were possible during the year. The new plates have a thinner colloidal film and are therefore much more sensitive to light which I think is desirable, but they are also more frail and have to be developed carefully. The apparatus has been working beautifully and has been giving no trouble of any consequence. At the present time we are running monthly



FIG. 5.—The leopard that stole the observatory chickens. Messrs. Hoover and Greeley and their "boys."

comparisons on the instruments and checking every instrument to see that no daily gradual deviation occurred when compared with its setting on the preceding month.

The native boys working here are rather interesting and the subjects of considerable observation. We have two working here and they are both married. However as many as six women come to visit them at a time and think nothing of walking nine miles across the desert from Berseba. They have only one small stone hut about eight feet square and they all retire in their spacious mansion regardless of number. None of their wives live up on the mountain, preferring Berseba which is more social. One of the boys is very conscientious and honest and on pay night this boy said, "Boss, I want to make speak with you." When I asked him what he wanted he made quite a speech about how long he had worked here and his expenses and ended by asking for a raise in wages of one shilling per month, which was such a colossal sum that I had to ask him several

times the amount to make certain I did not hear wrong. Very few natives can speak English so they are more valuable when they have been here a while. They were both very well satisfied when I promised to give them a shilling more for each year they worked here which meant that only one of them did get a raise.

It has been very cool here recently, the minimum night before last being 48° Centigrade, while only about a week ago the maximum was 34.1° Centigrade.

Under date of December 5, 1929, Mr. Moore writes from the California station:

Table Mountain has been breaking several records of late, and since today finishes the fourth year of observing here, I'll describe this a little. We have observed on 86.0 per cent of the days during the past year, as against approximately 77 per cent the first year, 80 per cent the second, and 83 per cent the third. We got every day in November this year, which month has always lost several days in other years. It was cloudy on December 3, breaking our run of 58 successive days, the second long run this summer, the other being 62 days. Prior to December 3, we had observed on 115 out of 120 successive days. During the summer we encountered more clouds than usual, but the fall has been better than usual, with skies equal to the best Chile skies on a great many days.

This has been the driest year (from July 1) thus far in the history of the Weather Bureau. I saw an article yesterday from San Francisco, which said that their normal rainfall to this date is 4.21 inches, whereas this year they have had 0.01 inch. This is quite in keeping with my prediction. It now remains to be seen if this yet proves to be a winter of very heavy precipitation.

On October 23, Mr. Zodtner, director of the station on Mt. Montezuma, Chile, writes:

At 5:20 a. m. Saturday morning, October 19, we experienced a very violent earthquake. It did a great deal of damage. There was so much dirt and so many rocks shaken down in the tunnel that I had some difficulty in getting the door open. Rocks were broken from the side of the tunnel and dirt and small stones were shaken down through the roof. A part of the pyranometer-galvanometer pier was shaken down. The control magnet was thrown to the floor and the needle system was turned around. The bolometer was moved about one-half a foot and barely escaped being thrown from its pier. The diaphragm on the prism face was shaken from the prism. In fact, the prism itself was dislocated but is all right. The clock pendulum was hit with stones but is O. K. The pyrheliometers were not touched in any way as I always keep them under a double cover and on the floor which protected them from rocks and dirt falling from the roof.

The sight of all this was almost too discouraging. To make matters worse, it was cloudy and the weather has been poor since. Saturday we cleaned out the tunnel. Checked the slit and found that it was all right. Next, set the prism at minimum deviation and checked it with the transit for verticality. After this, we reset the diaphragm on the prism and got the magnet facing west. Then tried to focus the bolometer but with poor success because of sky condition. Sunday, we set up the pyranometer-galvanometer which is functioning very well now. Then reset the pendulum after cleaning it. We then tried again

to get the bolometer back in focus. This seems to be causing the most trouble. The concave mirror was not displaced during the quake. After this, we set the control magnet and the sky had cleared so we tried observing just to see where we stood. On developing up the plate the swing proved very short and the definition was no good. Monday morning, as soon as the sun rose, we tried to get the bolometer back in focus, improving it somewhat.

We took three holographs and got a fair looking value but I was afraid to call it satisfactory. Tuesday morning, we again tried improving the bolometer position but made matters worse. This morning I improved the bolometer position materially and now feel that we have matters fairly well in hand.

PALEONTOLOGIC WORK IN EUROPE

By R. S. BASSLER,

Head Curator of Geology, U. S. National Museum

The outstanding accession to the division of stratigraphic paleontology in 1927 consisted of the Frank Springer collection of fossil echinoderms with his very complete library upon the subject and funds for the upkeep of both, which, by deed of gift, came to the Institution soon after Doctor Springer's death in September of that year. Doctor Springer's official connection with the Smithsonian Institution began in 1911 when he transferred his collection and library from his private museum in Burlington, Iowa, to Washington, and installed them in the National Museum where a room in the new building had been assigned him. He spent the winter and spring months of each year at Washington engaged in his scientific work, and the remainder of the time at Santa Fe, New Mexico, in business pursuits. Many of his scientific papers were published in the Proceedings of the National Museum, while his well-known quarto monographs, the *Crinoidea Flexibilia* and *American Silurian Crinoids* were issued by the Smithsonian Institution. His position on the scientific staff of the Museum was recognized by the honorary title of Associate in Paleontology

I had the pleasure of Doctor Springer's friendship for more than 25 years and was closely associated with him in scientific work from the summer of 1911, when he and I, assisted by Kenneth Chapman, his artist and now director of the Santa Fe Museum, packed the delicate specimens comprising his collection, which filled an entire express car, and saw them started safely from Burlington, Iowa, on their way to Washington.

The Springer collection, now comprising upward of 100,000 specimens, several thousand of which are types described in his publications, is undoubtedly the most complete assemblage of fossil echinoderms in the world. Doctor Springer never missed an opportunity to purchase good echinoderms, to employ collectors to obtain them, or to otherwise increase the collection. As some of his early purchases were unfortunately not labeled with the accuracy of detail as to geological horizon now demanded, he was always interested in remedying this defect by researches of all kinds. Business affairs prevented him from personally doing much field-work, but on various occasions he

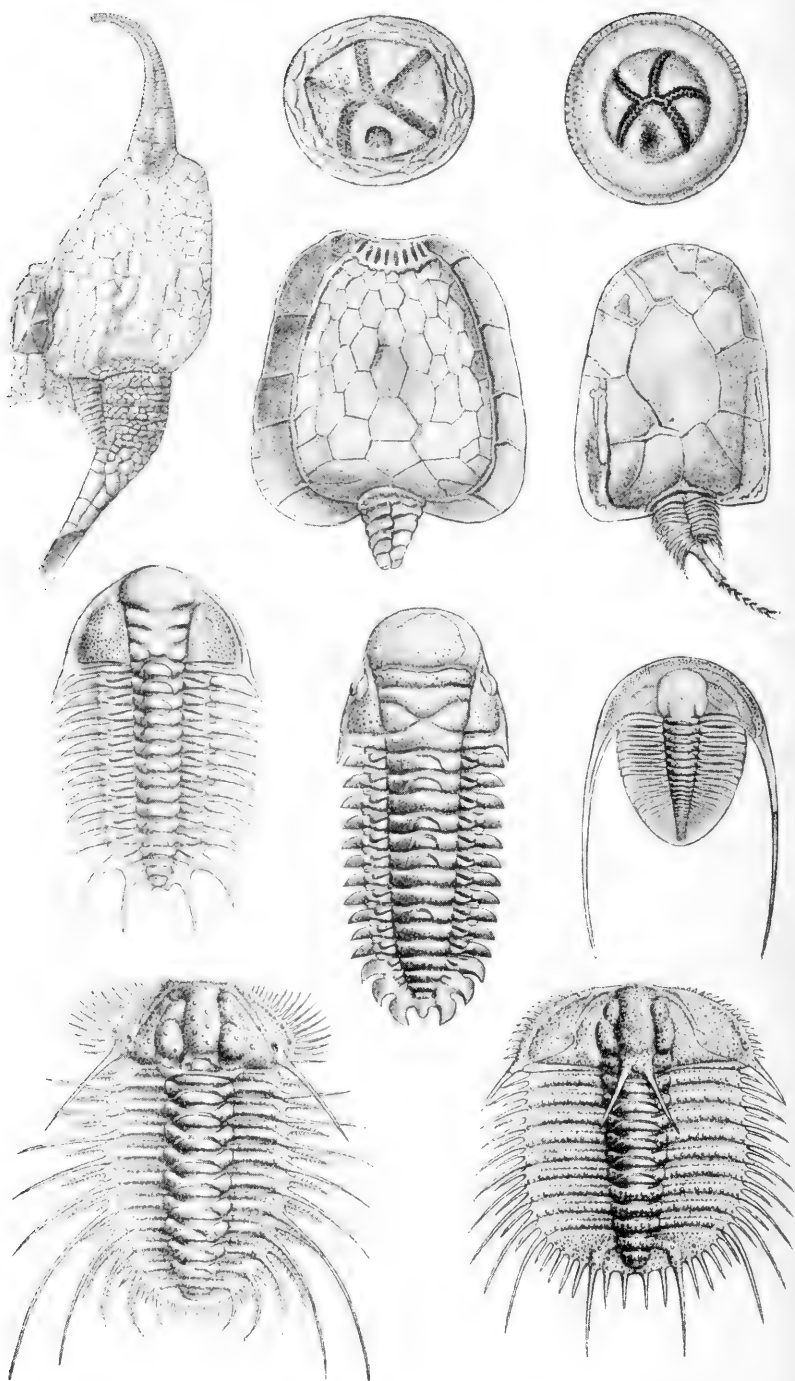


FIG. 6.—Characteristic types of cystids and trilobites from the Barrande collection.

sent me as well as others on trips to collect specimens and to study the stratigraphy of various classical crinoid-bearing areas in North America. Similar trips to European localities and museums were planned, but his lamented death prevented their fulfillment during his lifetime.

Notwithstanding the size of his collection, it necessarily lacked many species, particularly those represented only by the types in certain American and foreign museums. Realizing the value of casts of these types for comparative purposes, Doctor Springer made plans to secure them and obtained a considerable number from American museums. He especially desired casts of the echinoderms in the famous Barrande collection at Prague, and for this reason, in the summer of 1929, I prepared to carry out his wishes by going personally to Czechoslovakia to make the casts. I was, therefore, detailed to undertake this special work and also to collect and study in France and Germany in the interest of the collection.

Upon arriving at Cherbourg on August 3, 1929, various classical localities in the Paris Basin were visited under the guidance of Ferdinand Canu. A week was spent here in studying the Mesozoic and Cenozoic rocks, in collecting, and particularly in making arrangements with specialists in France for exchanges of echinoderms. An important result was the stratigraphic information secured, whereby many miscellaneous lots in the Springer Collection can now be accurately labeled. Several days were then spent in the Rhine Valley region where good exhibition specimens of Devonian crinoids and starfishes were secured. Following this, a week was devoted to similar work in central Germany, with particular attention to the Mesozoic strata. Through a friend of our Museum, Dr. Johan Weigelt, director of the Geological Institute of the University of Halle, I was able to arrange an exchange of not only fossil echinoderms but of other classes of animals and plants much needed in our study series. At Berlin, Leipzig, and Dresden, museum methods were studied and information secured for future work on other type specimens.

Leaving Dresden for Prague, I took up the most important work of the trip, namely, the casting of the Barrande types of fossil echinoderms preserved in the National Museum of Bohemia. This work was accomplished under most pleasant conditions due to the cooperation and assistance of Dr. Jan Koliha, curator of the Barrandeum, the division of the museum housing the Paleozoic collection assembled by the celebrated paleontologist Joachim Barrande. Dr. Koliha not only gave me every possible help in my work but also



FIG. 7.—View from the National Museum of Bohemia looking down Václavské Náměstí (Wenceslaus Place).



FIG. 8.—The National Museum of Bohemia, fronting on the Václavské Náměstí.

proved a kind friend in a strange country and particularly with a strange language. Due to his generous help, the work of casting the echinoderms was completed earlier than anticipated and I was able to spend some time in similar work upon the equally interesting trilobites and other groups of fossils.

It may be of interest to review the methods used in preparing these casts. In many instances the specimen is represented only by a mould in the rock—that is, a cavity once occupied by the fossil which has since been dissolved away. Barrande's illustrations of such specimens were made from guttapercha squeezes of the moulds, but, due to the better quality of material today, the squeezes now prepared prove even better copies than the figured types themselves. Whenever the actual fossil is preserved, an impression, or, in other words, a mould is made by first dusting the specimen with talcum powder and then pressing plastocene or modeling clay upon it. To save time, these impressions, carefully packed in pasteboard boxes to prevent distortion, were shipped to Washington where plaster of paris casts are now being made from them. This method of casting not only gives excellent results in showing detail, but is the safest means to employ for delicate specimens such as the trilobites in the Barrande collection. The lower half of figure 6 shows the delicacy and interesting variety of some of these trilobites while the upper portion illustrates some of the curious cystid types which comprise a large part of the Barrande echinoderm collection.

The Paleozoic rocks of Bohemia outcrop in a syncline or downfold which, in the vicinity of Prague, is cut through by the Moldau River, thus affording numerous natural exposures. These rocks contain an abundance of fossils which have long attracted attention. The first geological work of note in the region, however, was accomplished by Joachim Barrande who made Bohemia classic ground for the study of paleontology. Born in France in 1799 and educated in the École Polytechnique at Paris as an engineer, Barrande's first appointment was that of tutor to the grandson of Charles X, the Duc de Bordeaux, who was afterwards known as Comte de Chambord. When the king abdicated in 1830, Barrande accompanied the royal family to England, thence to Scotland, and finally to Bohemia, where at Prague he took up engineering work. In the course of this pursuit, his attention was called to the Paleozoic fossils of the region, and with the publication of Murchison's *Silurian System* in 1839, he was led to make a study of the supposed equivalent strata in Bohemia. He entered into this work on such a large scale, engaging many workmen to open up quarries and collect fossils, that he finally acquired an unrivaled collection



FIG. 9.—Side view of National Museum of Bohemia, with the head of Wenceslaus Place to the left and a characteristic zmrzlina (ice cream) cart in the middle.



FIG. 10.—Exhibition case in the Barrande division of the National Museum of Bohemia, showing the many quarto volumes and mementoes of Barrande.

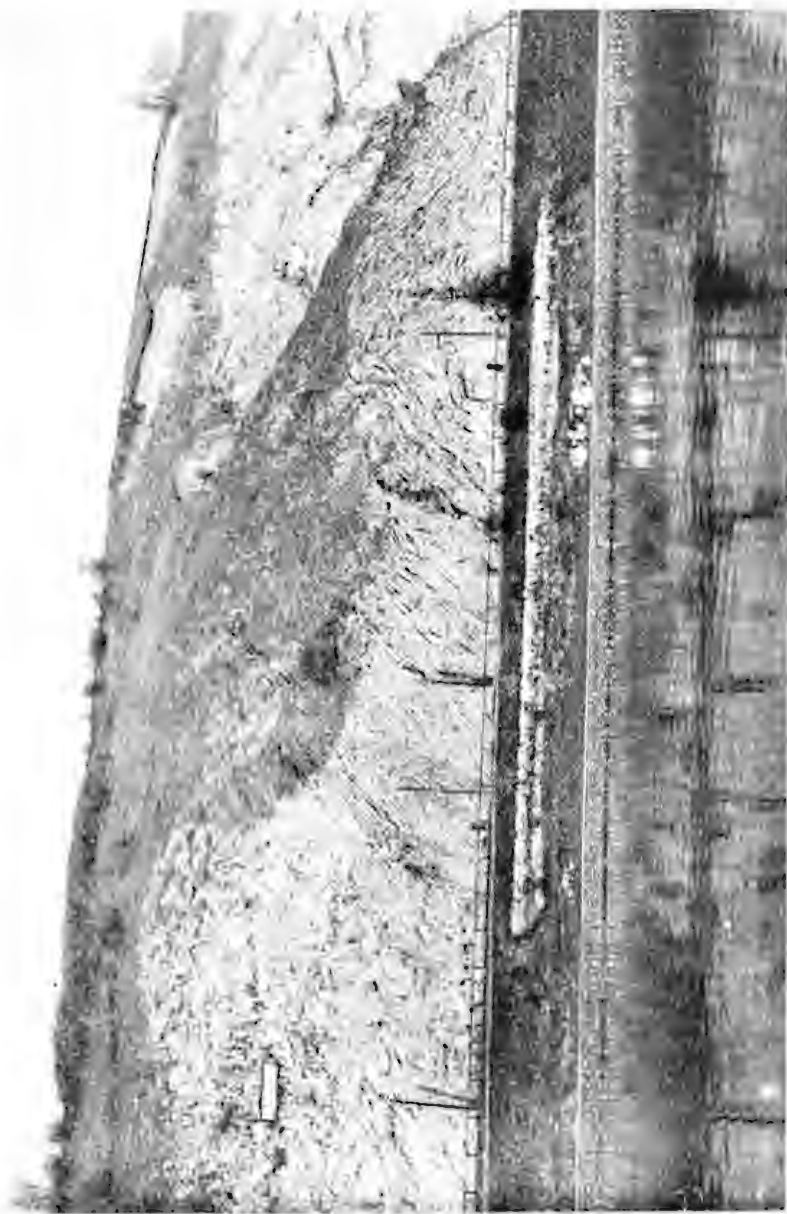


FIG. 11.—The Barrandeum Felsen, a cliff of highly folded Silurian rocks along the Moldau River near Prague. Barrande's classic rock marked with his name.

of trilobites, brachiopods, and other invertebrates, totaling about 3,500 species—all from rocks which he identified as Silurian but which have since been shown to include strata of lower and higher periods. The first volume of his great series of publications, the *Système Silurien du Centre de la Bohème*, dealing with the trilobites, appeared in 1852, and from then on he continued publishing until in 1881, 21 quarto volumes of text and plates had been issued.

Barrande's collection is housed in the Narodni Museum, the large, handsome building at the top of the Václavské Náměstí (or Wencelaus Place) which also contains the other natural history and historical collections of Bohemia. (See figs. 8 and 9.) The special division of the museum devoted to Barrande's collection, the Barrandeum, has been noted, but he is held in such high esteem at Prague that, to further commemorate him, an extensive section of the Paleozoic rocks along the Moldau River has been set aside to be available to future students. The very interesting portion of this section showing the greatly folded Silurian strata is known as the Barrandeum Felsen, and, as shown in figure 11, has Barrande's name printed upon it in large letters, visible to all travelers along the river, highways, and railroads passing along the base of the cliff, which faces one of the main traveled routes in Czechoslovakia.

One of the most interesting exhibits in the Barrandeum is shown in figure 10. At the top of a case devoted to personal mementoes of Barrande may be seen views of his old workshop in Prague, and one of the quarries he had opened for collecting fossils. The shelf below contains the great series of quarto volumes forming the *Système Silurien du Centre de la Bohème*, while in the lower part of the case are exhibited plates and text of two volumes together with his portrait, geological hammer, collecting bag, and other mementoes.

Leaving the charming city of Prague and its interesting people with much regret at the completion of my work, I spent a few days in Bavaria, particularly at the Alte Akademie at Munich, and in France before sailing for New York on September 21. In all my experience, this was my most successful field trip in making new friends, in securing new information, and in adding study material to the National collections.

FOSSIL HUNTING IN NEW MEXICO

BY CHARLES W. GILMORE,

Curator of Vertebrate Paleontology, U. S. National Museum

The San Juan Basin in the northwestern corner of New Mexico contains an extensive area of broken country called "bad lands" in which occur fossil remains of turtles, dinosaurs, and other extinct animals. It was in 1902 that the first fossil remains were reported from this region, and ever since, from time to time, the National Museum has been the recipient of small collections made by various members of the United States Geological Survey in the course of their explorations of the area. Especially noteworthy is a collection made by Dr. John B. Reeside, Jr., in 1916, consisting of no less than 50 turtles together with several fragmentary dinosaurian specimens. The excellent preservation and great variety of many of these fossils indicated a field of much promise for future paleontological exploration. Furthermore, the opportunity of establishing adequate faunas that would assist in the more exact correlation of these Upper Cretaceous formations with adjacent as well as more distant areas, made it a project having both paleontological and geological interest. Thus it was that the National Museum had long considered such an exploration.

Plans for this field-work were finally approved, and in May of the present year I left Washington for Kimbetoh, New Mexico. At Thoreau, the end of my railroad journey, I was joined by Mr. Norman H. Boss of the paleontological staff, who had been working for some weeks in southern New Mexico, and we proceeded by automobile to Kimbetoh, some 60 miles distant. On the way out we stopped at Crown Point where I called upon Mr. S. F. Stacher, superintendent of the Navajo Indian Reservation, who assured us of every assistance at his command whenever our work took us onto the Reservation. Our next stop was at the famous old ruin Pueblo Bonito, where we were delayed for two days because of the impassable condition, due to recent rains, of Escavada Wash, which lay between us and our destination. This was my introduction to a "wash," of which there are many in this country and with which we were later to become better acquainted. For those unacquainted with the term I may explain that a "wash" is nothing more than a wide shallow stream bed filled with sand, which in dry weather has no particular terrors after one

becomes accustomed to dust storms; but when this sandy bed is saturated with water it is a treacherous trap, and woe betide the unfortunate animal or auto that becomes bogged in these quicksands. Escavada Wash was not dry when we crossed, but with an experienced driver and a flying start it was navigated and we soon reached Kimbetoh. Here, following earlier arrangements, Messrs. George F. and Charles W. Sternberg had established camp some days prior to our arrival. The former had been engaged as field assistant and the latter as cook for the party.

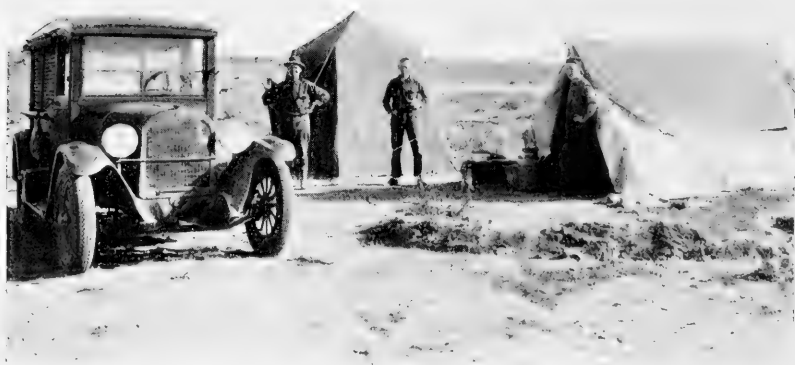


FIG. 12.—Camp at Kimbetoh, New Mexico. (Photograph by G. F. Sternberg.)

Kimbetoh lies well to the southern boundary of the area to be explored and it was planned to begin here and work north and west so as to close the season at Farmington on the northern border of the field. With slight modifications, this program was carried through.

The augmented party continued a systematic search of the surrounding bad lands but with rather indifferent success. A complete specimen of the large turtle *Neurankylus*, and a few dinosaur bones were all that was found worthy of collecting in the two weeks spent at this camp. From here we moved to Ojo Alamo, 16 miles to the north. This was formerly a well known trading post, but the fallen walls of the store and outbuildings are all that remain. A fine spring, however, makes this a congregating point for the Navajo Indians who bring their stock here for water. It is from this place that the geological



FIG. 13.—Articulated tail of hadrosaurian dinosaur as it was uncovered in the field. (Photograph by G. F. Sternberg.)

formation *Ojo Alamo* received its name. Little success was met with here, and after going over all the exposures within easy access of the camp without finding anything of importance, we moved to Hunter's store (now known as the Bisti Trading Company) situated at the edge of the Navajo Indian Reservation. Camp was pitched in the midst of an extensive area of bad lands made up of the Fruitland, Kirtland, McDermott, and Ojo Alamo formations. A few days of prospecting combined with the previous experience soon convinced us that the best opportunity for obtaining desirable material was offered by the Kirtland formation, to which, from this time on, our work was largely confined. An articulated tail of a large hadrosaurian dinosaur; portions of the skull of a horned dinosaur of the *Chasmosaurus* type, new to the fauna and probably a new species; articulated limb and foot bones of a small ceratopsian reptile; and no less than 20 turtles, many of them complete shells and some of large size, are a few of the outstanding acquisitions. The turtles pertain to the genera *Baena*, *Adocus*, *Neurankylus*, *Plastomenus*, *Aspideretes*, and *Amyda*. Many of these were found in places inaccessible by either auto or wagon and had to be packed out on our backs or lashed to the saddle of an Indian pony. At times the extreme heat and blinding sandstorms made the work of collecting very arduous.

On June 25, having covered all available collecting ground, camp was again moved some 10 miles north to Brimhall's Wash. From this time on, daily moves were made northward until the close of operations, a few turtles and fragmentary dinosaur specimens resulting. Much to our disappointment, the available collecting ground became progressively more and more restricted as we moved toward Farmington. Much of the surface was covered by windblown sand and it was only here and there that small patches offered opportunity for collecting. On account of these conditions, I decided to suspend operations some two weeks earlier than had been planned. The next few days were spent in packing the material collected which filled ten large boxes having a combined weight of 3,200 pounds.

Although disappointed by our failure to find more articulated specimens, we feel that the material acquired will contribute much of scientific interest. Several of the specimens apparently represent undescribed species and hence the known faunal lists of these several Upper Cretaceous formations will be considerably augmented. The turtles are exceptionally perfect specimens, and, with those already in the collections, assure to the Museum the most extensive series of Upper Cretaceous turtles in any institution in North America.

As a collecting field for fossil vertebrates, the San Juan Basin area, taken as a whole, is disappointing. Extensive areas of well



FIG. 14.—Ojo Alamo Spring, New Mexico. The spring is at the base of the rock to the right of the tree. (Photograph by G. F. Sternberg.)



FIG. 15.—Navajo Indian camp near Hunter's store, at the edge of the Navajo Reservation, New Mexico. The woman on the extreme right is a skilled weaver of rugs. (Photograph by G. F. Sternberg.)

dissected bad lands with surfaces practically free from vegetation and débris, an abundance of "float" or surface indications of fossils, are ideal conditions that give every promise of yielding rich returns. It was found, however, that in the greater number of instances, the clues followed led only to a single or at most two or three bones of a skeleton. It was readily apparent that individual skeletons had been widely scattered before interment, and that isolated or partially articulated specimens are rarities.

In conclusion, I wish to express my appreciation of the very satisfactory assistance rendered by all three of my helpers in the field. There was harmony and cooperation at all times and it was a pleasure to be associated with them.

FURTHER STUDIES OF CAMBRIAN GEOLOGY IN THE ROCKY MOUNTAINS

By CHARLES E. RESSER,

Curator, Division of Stratigraphic Paleontology, U. S. National Museum

The record of life in the Cambrian rocks of the Rocky Mountains, dating from almost the very beginnings of biological history, is slowly being revealed through the researches of geologists, and to the fact that the record goes back so far must be attributed the widespread interest in each new item uncovered. I was afforded the privilege during the field season of 1929 of continuing my studies of these ancient rocks and their contained fossils. My primary interest and effort, however, was directed not so much towards the discovery of new things but towards gathering data that will serve in systematizing our existing knowledge, for although much information and many fossils have been accumulated, these are not yet sufficiently digested to be generally available in a usable system.

As in past seasons, I used an auto truck and outfit that had been stored at the central location of Salt Lake City. Leaving there late in June, my assistant and I moved northward toward our chosen field in Montana. A pleasant feature of this year's work was that we were twice accompanied by Luciano Jacques de Moraes, a geologist of the Brazilian Geological Survey, who was visiting this country. He met us at Salt Lake City, and as several of our interests coincided, particularly the study of algal deposits, he accompanied us as far as the Yellowstone National Park. In the Park and along the route to it, we frequently stopped to study such deposits, obtaining much interesting information and some instructive specimens but also raising a new set of problems. For instance, last spring the rotogravure pictorial section of several eastern Sunday newspapers printed pictures of a large undercut boulder in the Gibbon River, several miles below the Norris Geyser Basin in the Park. We reexamined this boulder and found that its peculiar pedestal structure is due to the fact that its base is tightly cemented to the river bed by algal deposits, which prevents its turning over and thereby being rounded in the usual manner. But the unsolved problem raised is why algae should make a perfect concrete pavement for the river over the rapids at this point while both above and below no such lime deposition is taking place.



FIG. 16.—Dr. Moraes assisting with breakfast, early morning camp on Gray's River, Wyoming. The clouds of mosquitoes were almost dense enough to photograph. (Photograph by Resser.)



FIG. 17.—Outcrop of algal limestone of horizontal tubular form on Little Birch Creek, west of White Sulphur Springs, Belt Mountains, Montana. (Photograph by Resser.)

After Dr. Moraes left us early in July, we continued northward to the Bridger Range in Montana. Here some of the earliest work in the West was done and consequently the type localities of several Cambrian formations whose age has recently been brought into question occur here. As so often happens, restudy showed the stratigraphic history at this place to be much more complicated than previously thought. The Bridger Range has an interesting and peculiar structure for the Rockies in that the northern block is constituted of strata in normal order. Next south we find what may be called the Flathead Pass block which is completely overturned to the east while the southern block on the other hand again has the strata in normal superposition. Strange to relate the sequence of beds in the three adjacent blocks varies, which injects the difficult problems previously mentioned.

Camping on the west side of the Bridger Range is always pleasant as it affords a view across the fertile Gallatin Valley, probably the most productive portion of the State. Numerous towns and villages dot the floor of the depression through which flow the Gallatin Rivers on their way west to help form the Missouri at the western outlet of the Valley, beyond Logan. Terraces, composed of the exceedingly fertile Bozeman Lake beds whose soil is often over 500 feet deep, yield enormous quantities of dry-farming wheat of such high quality as to be almost world famous. The other topographic feature characterizing the Valley is the irrigated alluvial plains and meadows, all below the benches rimming the inner valleys. Here the towns are located, most of which are flourishing. Bozeman at the eastern and more extensively irrigated section of the Valley is an attractive city, containing a portion of the State University. On the bench southwest of Bozeman, where streams from the Madison Range furnish water for irrigation, a Dutch settlement has grown up, to which the inhabitants have given the aspect of a real Holland landscape. Logan, at the western end of the Valley, constituted our base for the summer's work because of its situation at the junction of the Butte and Helena lines of the Northern Pacific Railway, thus allowing mail to go directly to most other sections of the State. Since 1925, when a very heavy earthquake with its focal point near Lombard on the Missouri, caused considerable destruction of brick structures, Logan and the surrounding vicinity have experienced almost weekly shocks.

After ten days work in the Bridger Range we moved westward and northward across the Continental Divide into the Blackfoot country where the pre-Cambrian rocks were examined and an effort



FIG. 18.—Cliffs of pre-Cambrian limestone along Little Birch Creek, Belt Range, Montana. (Photograph by Resser.)



FIG. 19.—Cliffs of pre-Cambrian limestone, and camp along Little Birch Creek, Belt Range, on the Ringling ranch, west of White Sulphur Springs, Montana. In 1914 Dr. Walcott shipped in many tons of algal limestone collected in these cliffs. (Photograph by Resser.)

was made to find Cambrian sections not previously noted. Here giant pines and tamaracks break the monotony of the typical Rocky Mountain forest. Leaving this region we visited various ranges in southwestern Montana, all of which are composed of the same extensive series of pre-Cambrian sediments but lack younger beds. It is only in the ranges that the rocks are free from drift cover, which explains the method pursued, namely, crossing as many ranges and divides as possible. In some cases we used roads that are seldom traveled, least of all by automobile, but as a reward we usually found the streams full of trout. After going as far southwest as Salmon, Idaho, we turned eastward, crossing several ranges that still contained only the pre-Cambrian strata, finally reaching a Cambrian section on Camp Creek near Melrose, Montana. Since the rivers have rather easy grades for the most part and since snow banks at some of the higher levels persist until August, the mosquitoes hold on here almost all summer. We attempted to camp one evening at the end of July near Wisdom, but as soon as the car stopped we were at once enveloped in a cloud of mosquitoes, consequently we drove on up to Big Hole Pass, camping within sound of running water, although it was too dark to see the stream. This proved to be a fortunate location as eight trout were secured for breakfast within 15 minutes next morning while the fishing line froze stiff. Subsequently other sections in the Jefferson Range were studied and some of them measured.

We then turned to Logan and again met Dr. Moraes. Accompanied by him we made a loop to the northward, visiting particularly the Belt Mountains where Dr. C. D. Walcott had obtained interesting algal forms more than 15 years ago. Geologists have at times questioned the organic origin of these structures, and Dr. Moraes, who is attempting to solve certain problems in Brazil, wished to see these deposits in the field and thereby learn the criteria which led those of us who had previously studied them to believe in their organic origin.

Along the south end of the Belts in the canyon of Deep Creek certain shale beds of the Belt series have yielded fragmentary organic remains that have been interpreted as animal. These outcrops were located and some specimens secured. If these fossils could be proven to be animal remains they would constitute the oldest such examples known. But our studies have thrown much doubt on the animal nature of the fossils, indicating rather that they were algae akin in appearance at least to the flat sea-weeds of today. This interpretation is still further strengthened by the discovery of quite similar forms in the overlying Cambrian beds concerning whose algal nature there can be no doubt.



FIG. 20.—View on home ranch of Gilbert Cattle Company, near Alden, Montana. A nine-year old wild horse recently captured but not yet ridden. (Photograph by Resser.)



FIG. 21.—Another view on home ranch of Gilbert Cattle Company. Shetland pony and four of her five mule offspring. All the mules, which are now full grown, are pintos, a very rare thing. All will allow children to play about and climb on them, but will buck any cowboy off, if possible. (Photograph by Resser.)



FIG. 22.—Cambrian quartzites resting on the planed surface of deeply weathered old gneisses. This weathering happened before the Cambrian beds were deposited. Camp Creek, east of Melrose, Montana. (Photograph by Resser.)



FIG. 23.—Afternoon shadows creeping across the magnificent glaciated Teton Canyon, Wyoming. (Photograph by Resser.)

Each summer one notes an improvement in living conditions in Montana. About 20 years ago a great number of people moved into the State and took up homesteads in almost all possible situations. Houses were built, often at places to which water for domestic purposes had to be hauled considerable distances. The ancient soil was ploughed up and large quantities of wheat were produced by crude dry-farming methods. After a few seasons, the rainfall returned to normal and below, thus compensating for the moist years. At once these people began to feel want and soon were actually facing starvation. Hundreds of the houses were abandoned, the land either reverting to its wild state or being farmed by individuals or corporations having considerable capital. About ten years ago the modern era of diversification began. Since then people have learned not to depend solely on one uncertain crop but to keep a few animals and to plant every crop the climate and soil will permit. As a consequence today the people are making a comfortable living, the banks have large surpluses, and the population is increasing.

The latter part of the season was spent in a return trip to the western side of the Teton Mountains in Wyoming, extending the studies of the previous season. Several trips on horseback were made high up on the range to points just within the boundary of the new Teton National Park. At no other place in the world so far as I know are the different effects of granitic and sedimentary rocks on the development of topographic forms so clearly illustrated as along the crest of this range. A person standing on the small knob called Table Rock 11,000 feet above sea level and looking directly east will see deep canyons from which rises the spire of the Grand Teton to an altitude of over 13,000 feet, with precipitous walls of granitic rock whose height is measured in thousands of feet; if he turns either to right or left he will see cliffs of a different kind, the castellated masses and the gentler topography produced by the nearly horizontal Cambrian and younger shales and limestones resting on the gneiss. It struck me as I stood at this point that it is a great pity that the new national park does not include any of the sedimentary series of beds, but is confined to the jagged, granitic rocks. The full grandeur of the magnificent Tetons can be seen only from this point, which is reached by trail from the west side.

During most of the summer, particularly after July 10, the smoke from the numerous forest fires rendered photography difficult and at times impossible. Once or twice our camp was moved a little earlier than had been planned in order to escape the possible sweep of the fires.

HUNTING FOSSILS ON THE OLD OREGON TRAIL

By J. W. GIDLEY,

Assistant Curator of Mammalian Fossils, U. S. National Museum

Many a thrilling tale of adventure and hardship has been told by the pioneers who traveled the Old Oregon trail to the northwest in the early settlement of what was at that time wild, savage-infested country. Even today, especially along the Snake River Valley in Idaho, there remain abundant traces not only of the old trail itself but some of the tragedies that took place along its path as it wound its way through the desert, along the river, and over the rough lava fields. Those early pioneers traveling through Snake River Valley found the country through which they passed infested by Indians and teeming with big game in great variety. There were bison, the distinctively American antelope, the "pronghorn," elk, deer, bears, and wolves in great numbers. Today extensive irrigation projects have converted the fertile soil over great areas of the Snake River Valley into prosperous farming communities dotted here and there with towns and villages; and both the wild tribes of Indians and the big game animals, giving way to the advance of civilization, have vanished forever from this region. Today the big-game ranges, where not under cultivation, are entirely turned over to grazing lands for domestic animals, the bison, deer, and antelope having been replaced by horses, cattle and sheep.

Great as these changes have been, far greater took place in the ages of the past, long before the dawn of civilization. And, like the early pioneers of the Old Oregon trail, the inhabitants of that day have left traces which, intelligently studied, give us some interesting glimpses into their life history. These signs and evidences of a different past are presented to us in the form of fossil remains left in the slowly accumulated sedimentary deposits of lakes and stream channels which nature has formed in past times, and which in a more recent day have been uncovered in part through the cutting down of stream channels and the heavy rains of past centuries.

Usually these evidences of a different past are not intelligible or even recognized as such by the layman. It is only when such huge bones as those of the mammoth or mastodon are discovered or where bones are found protruding from rocks or in other unusual places that interest is developed in these evidences of a former animal life different from that of the present.

In the fall of 1928, Dr. H. T. Stearns, of the United States Geological Survey, sent to the National Museum for determination a small collection of fossil bones obtained at various localities in the Snake River Valley, and reported some prospects observed in his ground-water survey work of the general region. These specimens and reports gave such promise of good results that an expedition, which was placed in my charge, was organized by the Smithsonian Institution, for the following spring. Accordingly, leaving Washington on June 24, 1929, I proceeded to Idaho Falls, Idaho, where I had previously arranged to meet Doctor Stearns. The following few days were spent in reconnaissance trips by automobile which covered the major part of



FIG. 24.—Smithsonian Expedition camp at the edge of the desert near the Old Oregon Trail, Snake River, Idaho. Boxes of fossils in foreground ready for shipment.

the valley and included such localities as McCammon, American Falls, Twin Falls, and on westward to Bliss, a small town about 180 miles farther down the valley than Idaho Falls. Several prospects were thus examined and later more thoroughly explored. For this work a field party was organized in which I had for assistant Mr. C. P. Singleton, the discoverer of the important Pleistocene fossil locality, at Melbourne, Florida. The rest of the party included, as occasion required their services, Mr. Elmer Cook and Mr. F. V. Conklin, the men who first reported one of the good localities to Doctor Stearns, and Mr. Frank Garnier, all resident in the region of our work.

The purpose of this expedition was primarily to obtain good collections of fossil bones from the more important localities with a view

to determining the age of the various sedimentary deposits of the Snake River Valley and to secure material for study and exhibition purposes in the National Museum. Guided by our preliminary survey of the whole territory, certain more favored localities were chosen for operation, and the work was carried on with good success through two months, nearly 3 tons of fossils resulting from the expedition.

From a geologic standpoint one of the important developments of the expedition was the rather conclusive demonstration that most of the heavy gravel and sand deposits of the valley were accumulated during the last geologic epoch known as the Pleistocene, or "Ice Age." The fauna represented by the various fossil bones collected proved interesting and important. The pioneers of the Old Oregon



FIG. 25.—Typical view of Snake River Valley, Idaho.

trail, as has already been remarked, saw much big game on their journeys through this desert country, but the big game of our pioneer days was quite tame hunting as compared with what it would have been in that much earlier time of some 500,000 years ago. There were bison in that day also, but what bison! One kind common in that distant Pleistocene time was much like the present day type, both in size and general appearance; but a contemporary form, apparently quite as numerous, very much overtopped him in both size and development of horns. This bison was provided with great horns, each bony core of which was about two feet long and more than 6 inches in diameter at the base. In life these horns must have had a spread of not less than seven feet. But even this giant bison was not undisputed king of the range, for sharing it with him were great musk-ox-

like animals, exceeding in size by thrice his bulk the living musk-ox of the north country. Also vast herds of mammoths and mastodons, the former exceeding in size his living near relatives, the elephants of India and Africa, roamed at will over the country. Then there were ground sloths, large heavy creatures related to the living tree-sloths of South America, camels rivaling their Old World living relatives and even exceeding them in length of limb and neck. Great bears, and horses belonging probably to two distinct species, the larger about equaling in size a large cow pony, were abundant. Among the smaller animals are represented wolves, coyotes, beavers, pocket gophers, and hares.



FIG. 26.—Fossil bones uncovered but still *in situ* in gravel pit near American Falls, Idaho. In foreground is seen the radio-ulna of the large musk-ox-like animal. In the background, slightly to left, is a metapodial or cannon bone of a camel.

The fossil bones which give us this glimpse of the past were collected from several localities. Most of them were not found in view on the surface of the ground, but were obtained by systematic and careful excavating. Usually on this expedition gravel pits in which former excavation had revealed the presence of fossil bones were chosen for our operations. Here many cubic yards of the material were carefully worked over, and as bone after bone was thus brought to light they were taken out by the usual methods known to fossil hunters and carefully wrapped, labelled, and packed for shipment.

After completing the season's work in the Snake River Valley my detail took me to Bend, Oregon, where fossil bones had been reported

in one of the numerous lava caves of the region. My route was by rail down the Columbia River Valley to Sherman, Oregon, and thence southward up the Dessutes River over a branch of the Oregon Short-line Railway. This railway winds its sinuous way up through the gorgeously carved canyon of the Dessutes River, revealing at every turn new vistas of beauty and grandeur, for this canyon and its tributaries have been carved deeply by nature's agencies through enormously thick and widely extended beds of consolidated lavas, leaving many precipitous canyon walls and here and there rugged isolated buttes of solid lava rock. Arriving at Bend we were welcomed by Mr. W. J. Perry, a government forester who had first reported the fossil bones. The following day all hands with Mr. Perry conducting the party, proceeded to the exploration of the cave. These caves are peculiar and not at all like the ordinary caves of limestone regions. Instead of holes or excavations consisting of irregular chambers and intersecting passages eaten out by the action of acid-bearing waters which have operated to form the great caverns of limestone regions, we find here extended underground tunnels or tubes of relatively uniform size which were formed by melted lava streams continuing to flow for long distances after the main mass of the lava outpourings, which once covered thousands of square miles of that general region, had become partially consolidated. The present day entrances to these tunnels, when such can be found, are evidently spots where the supports of the tunnel vaults were not perfectly arched and these weaker places have given way to earth tremors or other extra strain. Where these weaker spots were near the surface they have caved in, forming the openings. It was through such an opening we entered the "fossil bone cave" as it has been named by Mr. Perry and is locally known. Equipped with miners' lanterns we followed back along the more or less even floor of the cave for several hundred feet, encountering here and there great rugged piles of lava rock broken down from the roof of the old passage left by the lava stream. Over these we were obliged to scramble to reach again the more even floor of the continuing passage way. When we had reached one of these piles of fallen rock about 3,000 feet from the spot where we had entered and where the old lava channel forked to form two passage ways, Mr. Perry announced we were near to the spot where he had first discovered the fossil bones. A little search on our part soon revealed more of them and in a few hours we had made a small collection by which we could judge of their nature and form some intelligent idea of their history.

How did these bones get into such a place, back in this black darkness more than a half mile from the nearest known entrance? And to what age did they belong? These are questions at first not easy to answer. Mr. Perry's first impressions had been that they were bones of animals that, having fallen into or taken refuge in the opening, had been washed by former stream currents or dragged by other animals back into the far recesses of the cave. But later investigation revealed the fact that most of the larger bones were broken and that all were more or less scattered about and mixed with the broken débris of the fallen roof. This would not have been the case



FIG. 27.—Opening to lava cave about 15 miles south-southwest of Bend, Oregon.

had the carcasses been transported there before maceration of the fleshy parts had taken place. If, however, it is assumed that the bones of animals living in the country over these caverns should from time to time have fallen into cracks and crevices of the lava covering, they might readily work their way downward by shifting and slight earth movements until, aided by this cave-in, some of them found a more permanent resting place at the bottom of the cavern among the fallen débris of the roof. Careful search with our lanterns revealed that there were such crevices in the irregular broken vault of this portion of the cavern. The animals represented in the small collection which included an extinct species of horse and a large hyena-like dog, indicated that they were not recent forms but belonged to the last geologic period just preceding our own time, the Pleistocene.

INVESTIGATIONS OF EARLY MAN IN FLORIDA

By J. W. GIDLEY

Assistant Curator of Mammalian Fossils, U. S. National Museum

In 1916, Dr. E. H. Sellards, then State Geologist of Florida, reported the discovery at Vero of human remains associated with those of an extinct fauna. Because the specimens obtained were fragmentary, relatively near the present surface of the ground, and especially because the character and origin of the deposits in which they were found was little understood, much controversy arose at the time both as to the age of the deposits and the question of whether or not the association surely indicated contemporaneity of man with the animals represented by the fossil bones with which they were found. A series of explorations and investigations was begun in 1925 by a joint field expedition of the Smithsonian Institution and Amherst College, and has since been continued independently by the Smithsonian as funds have permitted. The results of these systematic investigations, which were placed in my charge, have been published from time to time.¹

This work has fairly well established the contention that man reached Florida at an early date and lived there with an assemblage of wild animals different from that of our own time, but there is still some question as to what phase of the Pleistocene they belong. Beginning in March, 1929, I spent about two months at Melbourne in investigation by much the same methods as those adopted the previous season, with equally gratifying results. Not only was additional material secured which will aid in the determination of the age of the "No. 2" beds, but an added piece of evidence of the contemporaneity of man was secured. This evidence consists of a stone artifact of unique design, known as a turtle-back scraper found *in situ* about the middle of the "No. 2" bed. It lay in the undisturbed semi-consolidated sand of the fossil bone-bearing layer and near it and about at the same level were found bones of several extinct species of animals including elephant, mastodon, horse, camel, tapir, and a large bear. An added proof of the antiquity of this stone implement is seen in the patina it has acquired, which is of a character that indicates great age.

¹ See especially Gidley and Loomis, Fossil Man in Florida, *Amer. Journ. Sci.*, Vol. 12, pp. 254-264, 1926; Gidley, Further Study of the Problem of Early Man in Florida, *Expl. and Field-Work Smithsonian Inst. in 1928*, pp. 13-20, 5 figures, 1929; and Gidley, Ancient Man in Florida: Further Investigation, *Bull. Geol. Soc. Amer.*, Vol. 40, pp. 491-502, 2 pls., 1929.



FIG. 28.—Beginning of east extension of East Pit, Golf Links, near Melbourne, Florida.



FIG. 29.—East Pit, showing bones of a partial skeleton of a small mastodon still in place in No. 2 bed.

COLLECTING BORON MINERALS IN DEATH VALLEY

By W. F. FOSHAG,

Curator of Mineralogy and Petrology, U. S. National Museum

Borax, before its discovery in California and Nevada, was a rare commodity, much of it being brought to Europe from the high Himalayas of Thibet. The Western United States borax districts have produced in great quantities, the industry being famed for the *twenty mule teams* employed to haul the raw material from the floor of Death Valley, over the steep Panamint Mountains and across the inhospitable desert to Mohave, 165 miles away. Recent discoveries having brought about the abandonment of the old mines for richer and more accessible fields, it was deemed desirable to study these old deposits and collect their minerals while the workings are still open. The type of boron deposit found in this region is unique in its occurrence. The chief ore mineral is colemanite, a borate of lime, which is not known from any other locality in the world. Other mineral species, too, are peculiar to this arid region.

Early in March, 1929, in company with Mr. F. A. Gonyer, I left Barstow, California, by motor for Death Valley. This desolate region, once so rarely visited by any one but hardy prospectors, is now readily accessible. Our route lay through desert valleys, barren except for sagebrush and joshua trees, and over mountains of granite and lava to Cave Springs. From here we could look into the south end of Death Valley as it lay almost at our feet. Our first camp was at Saratoga Springs, a favorite watering place for the desert prospector, and here we found four of these interesting characters domiciled in the ruins of an old stone cabin. Here the drifting sands have made a small basin that retains the overflow of the several springs issuing from the foot of the mountain and formed several small ponds, the home of wild ducks, mud hens, and a small desert fish of the genus *Cyprinodon*.

From Saratoga Springs we went up the valley by way of Rhodes Wash and Bennett's Wells. On either side are high mountains, between them the narrow valley, often less than ten miles wide. In the bottom of the valley are sun-baked muds and wide stretches of alkali and rock salt, and on the alluvial slopes, rocky wash with scat-

tered clumps of creosote bush or mesquite. The mountain slopes are devoid of all vegetation and soil, exposing only naked rock.

The eastern wall of the valley is precipitous and almost unscalable, formed of brilliantly colored volcanic rocks rising 5,000 feet above the floor. The western wall, the Panamint Range, is made up of granite, limestone, and volcanic rocks, rising to an elevation of 10,937 or 11,240 feet above the floor. During six months of the year the highest elevations of this range are capped with snow, the melting of which feeds the springs along the western border of the valley.



FIG. 30.—Saratoga Springs, south end of Death Valley. The surrounding limestone mountains are almost bare of vegetation. (Photograph by Foshag.)

At Furnace Creek a good cabin in the lee of a high cliff was utilized as a camp. Violent winds often swept down the wash at night, rattling the tin cans among the boulders; other nights were beautifully starlit and silent. Down the wash are clay hills containing some of the most interesting of the mineral localities, while in the opposite direction lies Ryan, the center of the borax mining district, on the flank of Mesa Negra.

The borax beds are found in a number of localities in and about Furnace Creek Wash, a boulder-strewn dry stream channel flanked by hills of sands, clays, and volcanic flows. These clay and sand hills present a peculiar appearance. They are deeply dissected but with



FIG. 31.—The floor of Death Valley, showing the rough salt beds. (Photograph by Gonyer.)



FIG. 32.—Furnace Creek and the Funeral Range, Death Valley. The hills in the foreground are shales and carry borate minerals. The mountains are limestone. (Photograph by Grinnell.)



FIG. 33.—A part of Mount Blanco showing a thick bed of borax ore. Death Valley in the distance. (Photograph by Grinnell.)



FIG. 34.—Mesa Negra and the camp of Ryan. The borax mines can be seen to the right of the camp. The summit of the mesa is a broad flow of black lava. (Photograph by Grinnell.)



FIG. 35.—Collecting minerals at Pluto's Salt Pools, Death Valley. In these natural "blow-holes" fine groups of salt and other crystals can be obtained. (Photograph by Foshag.)



FIG. 36.—Excavating for borax minerals in the floor of Death Valley. The minerals are found in the mud at a depth of a few feet. (Photograph by Foshag.)

smooth slopes covered by a soft, puffy soil and absolutely barren of all vegetation—not a spear of grass modifies the variegated color of their slopes. In these shales and sandstones the borax ore occurs in beds or large lenses interstratified with the shales. It consists of the



FIG. 37.—Bringing out the specimens. The minerals resulting from the work shown in figure 36 are carried over the rough salt to the automobile. (Photograph by Grinnell.)

minerals colemanite with minor amounts of meyerhofferite, both borates of lime, and of ulexite and probertite, borates of lime and soda. Other rarer minerals are found. In the workings made to explore these deposits, numerous vugs lined with beautifully sharp, clear crystals are found. Groups of these were carefully removed and prepared for shipment.

On the floor of Death Valley is an extensive accumulation of salt and other minerals. We made excavations in this area to determine the mineral character of the salt. Saturated brines are found immediately below the surface and in the "blow" holes in the salt crust we found fine groups of halite crystals.

After the completion of the work in Death Valley we proceeded to the Calico Hills, a brilliantly colored range of mountains lying immediately north of the town of Yermo, San Bernardino County, California. Borax has been produced here in important quantities, but the old camp is now fallen into ruins and we made our camp in a dugout in the clay walls of the canyon. Since the mines have been abandoned for some years and have caved in, our work was confined to the surface exposures and shallow openings. The ore was entirely colemanite, much of it in the form of hollow spheres lined with limpid crystals. Light blue crystals of celestite, a sulfate of strontium, are found in these geodes, and with the colemanite form striking specimens.

Our next locality was the new borax mines near Kramer, California, now the only locality where borax is mined on an extensive scale. These mines are extraordinarily rich, sufficient borax for several centuries at our present rate of consumption being already available. The ore is pure sodium borate or borax and contains much kernite, a newly discovered borate of sodium. These mines, together with the chemical plants at Searles Lake where borax is obtained in the process of recovering potash from the lake brines, supply the entire world with borax. Shafts driven to a depth of 500 to 1,000 feet reach the borax bed, from which drifts leading in various directions penetrate the ore. These tunnels are driven through masses of solid mineral; their walls are snowy white with borax or glistening with icy kernite.

We visited other borax mines including those of Lang, California; White Basin and Callville, Clark County, Nevada; and the Chetco River, Southern Oregon.

Besides these mines of borax we examined a number of the playa or dry lake deposits. These playas are the bottoms of the intermontane valleys, and having no outside drainage, are the basins for all the salts leached from the encircling rocks. In the early days of the American borax industry this mineral was recovered from these alkali flats. Some of these playas are of considerable extent and contain a variety of salts: sulfates, chlorides, carbonates, and borates of sodium. In the muds that underlie the alkali crust are found large and well developed crystals of the various minerals. To collect

these is often a tedious and disagreeable task. The sticky, tenacious clays are saturated with brine and to collect the crystals we often found it necessary to lie prone in the mud and alkali. The material so collected, however, is of interest and importance for the study of these little known occurrences.

The mineralogical information obtained during the trip adds much to our knowledge of the boron minerals, a group that has received little scientific attention. The specimen material acquired augments the fine collections of this character already in the National Museum. Some striking groups of fine crystals were collected for exhibition.

For the privilege of visiting many of the mines, acknowledgment is due Messrs. Zabriskie, Rasor, Osborne, and Gower of the Pacific Coast Borax Company, as well as a number of other friends who have contributed both to the success of the undertaking and to the comfort of the members of the expedition.

A VISIT TO EUROPEAN ZOOS

By W. M. MANN,

Director, National Zoological Park

For the purpose of studying some of the more important European zoological parks, the writer and Mr. Arthur L. Harris, Municipal Architect of the District of Columbia, visited Europe in the spring of 1929 under the auspices of the Smithsonian Institution. Our principal object was to look over the reptile houses with a view to including in the proposed building at the National Zoological Park some of the features proved best by experimental work that several of the European zoos have been able to do. In addition we made a rather hurried survey of the organization of each zoo, together with notes on the collections, cost of maintenance, etc. Mr. Harris devoted most of his time to a study of zoo architecture.

In the limited space of the present paper it is possible only to mention briefly a few of the outstanding features of each zoo visited. In general we may state that we did not see a single unsatisfactory zoo park on the entire trip. The collections were excellent, always well cared for and well patronized by the public. Most of the gardens are developing and improving continually, and we saw new buildings under construction in practically every park visited. There are no free zoos in Europe.

To acknowledge the kindness of those who assisted us in our work would be to catalogue the officials of all the parks visited, all of whom received us with the greatest hospitality and made our visits delightful as well as instructive.

LONDON (Director, Sir Chalmers Mitchell)

The London Zoological Garden has a collection larger than any other in Europe. We noted many improvements since our last visit of five years ago. A splendid reptile house has been constructed on new principles; the heating and lighting are accomplished entirely by electricity and every inch of glass in the house is Vita-glass. The combination of this and the use of various types of infra-red and other lamps has proved markedly beneficial to the inhabitants of the house, and we found such things as chameleons and Komotu dragons, hitherto considered delicate, living, not for a few months, but for

years. Aquarium-style lighting is used throughout, the visitor being in subdued light—an arrangement which gives the best visibility we have seen in such houses. Among the new features in the garden is a house built especially for turtles and tortoises and containing a large collection.

With apparently every traveling or foreign-residing Britisher bringing or sending home animals to the zoo, the collection stands out among all others. Super-rarities that we saw were the marsupial wolf and the takin. In the aquarium were all three species of lung fish.



FIG. 38.—Keeper with the rare New Guinea spiny anteater, London.

HANOVER (Director Mueller)

The zoo at Hanover, formerly run by a zoological society, was taken over by the city in 1924. Since that time the collection has been greatly enlarged and a number of additional buildings have been erected. The new monkey house has a deep space behind the cages filled with palms and other plants and the outside cages are unusually high. A new small-mammal house is under construction.

One of the interesting features of this zoo is a little outdoor enclosure for guinea pigs with a house in the center, the whole separated from the public by a cement wall only six inches high. When we asked if people did not sometimes take these guinea pigs away, we

were informed that on the contrary children sometimes smuggled their own pets into this enclosure, apparently delighted in seeing them so prettily housed and well cared for. Features of the collection were oryx, beisa, five elands, giraffe, rhinoceros, and six zebras.

HAMBURG (Director, M. A. Hans Bungartz)

Perhaps because of the competition of the zoo at Stellingen, only 20 miles away, the Hamburg Zoo is not developing as fast as some of the others. There are many fine old buildings and the collection



FIG. 39.—Penguins at Stellingen, in naturalistic rock pool.

was very fair. Especially interesting were the small mammals, which are brought to Hamburg in great numbers and varieties on German ships.

STELLINGEN (The Hagenbecks)

Much has been written about this magnificent private enterprise founded in 1905 by Carl Hagenbeck and since then maintained by him and his sons. The Stellingen panoramas, the first of their kind, and since often copied by other zoos, are the predominant feature. Because the proprietors of the zoological gardens are also dealers in animals, the collection changes continually and large herds



FIG. 40.—Patagonian sea elephant, Stellingen. Compare with ordinary sea lion in central foreground.



FIG. 41.—Mammoth sea elephant, Stellingen.

of rare things are sometimes maintained. For instance, at the time of our visit, one hundred penguins were disporting in two large rock-work pools. There were a whole troupe of elephants with Hindu mahouts, elephant seals, and large flocks of flamingoes at liberty about the grounds.

Here we find one of the best insect exhibition houses in all Europe. The curator is an elderly German entomologist, who takes the same care of and interest in his specimens as the elephant man takes in his. In showing us his charges, he took into his hand big scorpions, a six-inch centipede, and giant spiders.

BERLIN (Director, Dr. Ludwig Heck)

The Berlin Zoological Park is the third oldest in Germany, having been opened to the public in 1844. The present director, Dr. Ludwig Heck, has been in charge since 1888. The buildings, of which there are many, are commodious, well-planned, and most attractive to look at. Some of them are beautifully decorated, and the architecture, borrowed from many lands, is usually suited to the nationality of the inmates. Many of the buildings boast paintings, carvings and stained glass windows. Some 3,000 animals and birds are exhibited, 400 species of the former and 1,000 of the latter.

The newest building is the aquarium, a mammoth three-story structure, the first floor devoted to fishes, the second to reptiles, and the third to insects. The bird house is at present being remodeled, for in spite of the fact that the buildings are among the very best in European zoos, they are continually being improved and enlarged, and new ones are being built. The rodent house is two stories high, the lower story being cut into the bank and with outside barless pits for many small animals, an exhibition fascinating to children.

The collection is superb. Thirty species of deer are exhibited, 6 giraffes (of three species, including the rare *cottoni*), 12 gelada baboons in one cage, a black howling monkey that has lived here two years, and 9 species of lemurs living together. The number of young animals born here is surprising; we saw a black lemur with two babies, some young hyrax, and a mother elephant with young.

DRESDEN (Director, Dr. Gustav Brandes)

The Dresden Zoo was started by a society of poultry fanciers in 1859, and in 1860 a corporation was founded which took over the gardens and added to the collection, forming a more comprehensive zoo.

Dr. Gustav Brandes, the director, is a well-known student of the orang-outangs, and his collection of these is notable. They are kept in a temperature very humid as well as warm, under a Vita-glass roof, in large cages which have wire mesh instead of wooden floor, with logs arranged so that the animals never come to the ground but live their natural lives in the tree tops. The gorilla is kept under the same conditions. The most astonishing sight we saw in any zoo was Dr. Brandes going into a cage with a family of orang-outangs, the



FIG. 42.—Flight cage, Dresden. Artificial rock work and waterfall add greatly to its attractiveness.

male 12 years old, the female 15, and a two-year-old baby, the latter born from other parents, and still another young one that had been born in the zoo at Dresden. Dr. Brandes goes in among these four orangs, and calmly feeds them and brushes them, even brushing the five-or-six-inch-long hair on the male. When he came out of the cage he informed us that the male had been captured as an adult only 18 months ago.

The sea-lion pool is unusually large. There are big rocks for the seals to dive from, and a chute for penguins to slide down into the water. The rock work in the reptile house is made up of samples from all over Germany and forms a geological collection of interest.

The great flight cage for the eagles was the finest we saw. It is oval in shape, about 200 feet long and 50 feet high, with all the construction on the outside so that the inner space is left entirely open for the birds. The background is formed by a rocky cliff, so that the birds may be viewed from above as well as below.

Despite very cool and rainy weather the zoo was crowded, and one can see why, for there are many unusual features here, including a pair of elephants, one of them an African, which performs daily, as do lions and chimpanzees.

LEIPSIC (Director, Johannes Gebbing)

The Leipsic Zoo was started in 1876 with a small structure built especially to house a little collection of crocodiles, but soon developed into one of the foremost gardens of Europe. As you enter the gardens you are confronted by an enormous cliff of rock work, pierced by a tunnel and a grotto with artificial stalactites. Down one side of this mountain tumbles a water-fall, on the other side is a semi-circular cavern which serves as a bandstand. It was Whitsuntide, and the crowd in the park was so great that we had to worm our way through even in the early morning.

The finest building is a new pachyderm house, an enormous brick structure with barless enclosures both inside and out, the animals being separated from the public only by pits. The indoor hippopotamus pool, a very large one, was partially sheltered by a shelving rock which was thickly planted with flowering tropical plants.

The collection is large and contains many great rarities, with a choice collection of fishes and reptiles.

HALLE (Director, Dr. Fritz Schmidt)

This is a mountainous zoo, built on a hill in a series of terraces, with paths winding up the hill and around the cages. The finest building is the lion house, built in 1926, which has also an outdoor tiger cage 40 feet in length. The hillsides have been excavated here and there and cages set in for various small mammals, an attractive and practical arrangement. The monkey house is small but well lighted and arranged. In a small aquarium building were 100 small tanks with a collection of European fishes and batrachians.

MUNICH (Director, Hans Heck)

This, the geo-zoo of Europe, was opened only two years ago. The park is well out of the city, and comprises 35 hektares of mostly

wooded country, bounded by steep wooded hills on one side and by the river Iser on the other. The city of Munich gave the land but the zoo is maintained by a private society. Its popularity can be judged by the fact that two-thirds of the entire population of Munich visited it the first year.

The animals are arranged according to their native continents. One tropical house has been built and several more have been planned. Already the collection contains 2,500 birds and animals, with larger herds of each species than is usual in zoological gardens.



FIG. 43.—New tropical building, Munich. The outside elephant paddock is separated from visitors only by a moat.

The pachyderm house is the best lighted large house that we saw. An open air lion pit, with one portion 100 feet long, is separated from the public by a water-filled moat. The domestic animals of each continent are together in very large paddocks. The penguin pool contained 17 specimens of 4 species. In the South American group were a pair of breeding Patagonian caviars, and we later secured a pair of young ones from these for the National Zoo.

The African steppe is 350 meters long and contains zebras, 30 crowned cranes, Abyssinian guinea fowl, antelope, storks, herons, spur-winged geese, and gnus. Two acres are enclosed in a monkey pit inhabited by 100 hamadryas baboons. The elephant pit is 3 acres in extent, with a 50-foot bathing pool.

With plenty of area and definite plans, only lack of money can prevent this from becoming one of the most notable zoological gardens in the world.

NUREMBERG (Director, Dr. Karl Thäter)

At Nuremberg the zoo is built around four large lakes included in the grounds and covering half the area of the park. Built over one

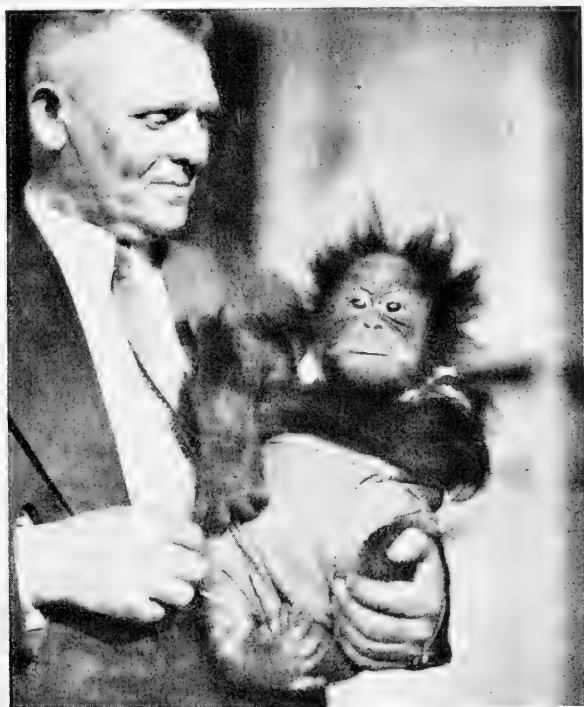


FIG. 44.—Baby orang at Nuremberg.

of the lakes is a reproduction of an old German lake house. As in other German zoos, this zoo makes the most of its natural scenery. Where scenery is lacking, they create it. So we find an artificial cliff with the water tumbling over it, and along the edge of one lake a great thicket of rushes with roe deer actually breeding there and 30 flamingoes walking along the shore.

The lion and tiger pits are unique. One views the animals from a bridge built over the lake. The lake is used by the tigers as a swimming pool and every day they can be seen disporting in the water. The sea-lion pool is enormous. At one end is an artificially-built cliff from which the five sea-lions have been taught to leap into the water.

FRANKFURT (Director, Dr. Kurt Priemel)

The Frankfurt zoo is next to the oldest in Germany; it was founded in 1858 and moved to its present location in 1874. There are about 3,000 animals and birds in the collection which is the second finest in Germany. This was the first zoo to use a glass house for reptiles and the first in Germany to have an exhibition of insects. It was also the first to use plants and rock work in reptile cages.

The collection contains two fine giraffes, a rhinoceros, and three varieties of elephant (one of them, formerly with the Ringling Circus,

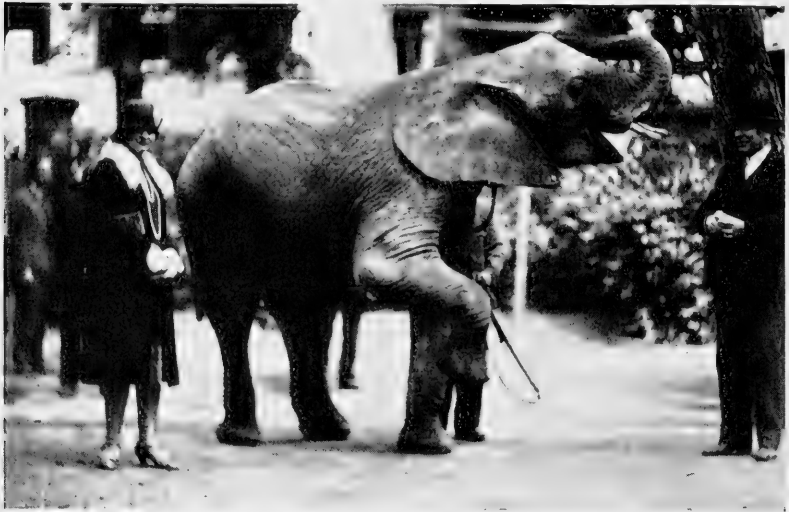


FIG. 45.—African elephant, Frankfurt-am-Main, with Director and Frau Priemel.

has been living here for 15 years.) The African elephant is very tame and is daily led about the grounds. Orangs have bred in the zoo, and there is now a breeding pair of sloth bears. Two armadillos arrived the same afternoon that we did, and the following morning they had dug themselves in the ground and out of sight. Twenty-four species of hornbills live in the park; a pair of Jackson's hornbills was breeding. The female had been sealed with mud in a wooden box nest by the male, who brought food to her when it was placed in the cage.

In the aquarium and reptile house we saw the giant Amazon turtle, *Podocnemus expansa*, which had been living there for six months, and a Chinese alligator that arrived in Europe in 1886. A monitor, now six feet long, was only six inches long when it came to the zoo.

COLOGNE (Director Hauchecorne)

The Cologne zoo was established in 1857, and is now maintained by the city. The complete collection consists of 1,600 animals and birds, including 2 giraffes. In times past 6 giraffes have been born in the park, and sea-lions have also been bred here on two different occasions. The polar bear pits and the sea-lion pool are unusually good. The bird collection contains many rarities, among them the only West Australian cockatoo (*Calypharynychus stellatus*) that we saw in Europe.

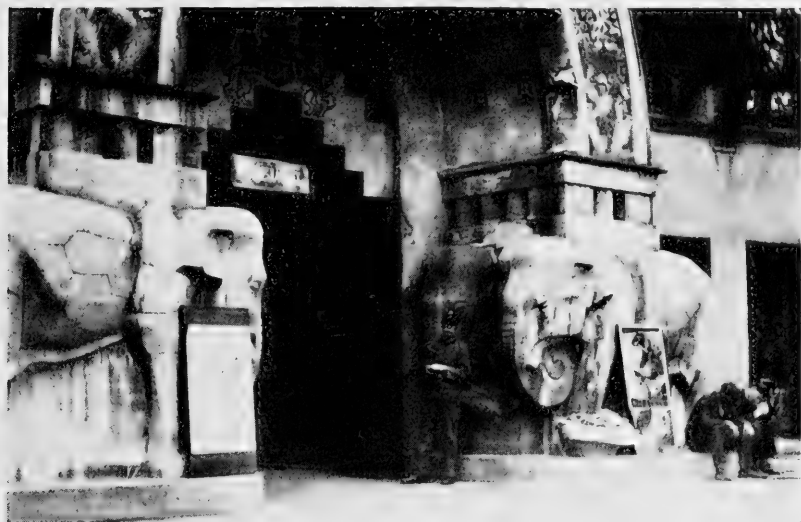


FIG. 46.—Entrance to Zoo at Budapest.

DUSSELDORF (Director Georg Aulmann)

This zoo, established 52 years ago in a park of 16 hectares, now has a collection of 1,500 animals. A new monkey house 130 feet long with an open pit all along one side is now under construction. In the old monkey house were three gorillas, one of them Susi, who afterwards came to America on the Zeppelin. The other two are a mixed pair, one from the Cameroons and one the mountain gorilla. The five woolly monkeys that we saw here had been in the park five and a half years. Of the three orangs, one is the largest in captivity.

A feature of this zoo is a little railroad that takes children around the park on Sundays. A small natural history museum is under construction.

ELBERFELD (Director Keusch)

The Elberfeld zoological park, opened in 1881 by a corporation, is very hilly and the most beautifully gardenized in all the world. The present director was formerly head gardener at Potsdam under two kaisers and has brought with him his flair for creating beautiful landscapes.

There are three new buildings, as follows:

1. The monkey house, which has open pits inside as well as out. A profusion of plants grow in the building, with a small palm garden and pool in the center. An interesting feature was an arrangement for artificial rain; the director turned a crank and we saw a tropical downpour in the building.

2. The aquarium, reptile house and insectarium, another small building exquisitely planned. Plants were blooming in nearly all the reptile cages.

3. The elephant house, which contains a big pool at one end for hippopotami. One big elephant cage occupies one side of the house, and three smaller cages for tapir and rhino fill the other side.

The outdoor panorama is especially interesting. It is in three sections, one for seals and sea lions, another above for polar bears, and a third for reindeer and ibex. A fairly comprehensive view of the whole thing may be obtained from below, but passages between each panorama permit the visitor to approach more closely to the animals.

VIENNA (Director, Dr. Otto Antonius)

The Vienna zoo, at present maintained by the city, is the oldest in Europe; it was begun about 150 years ago by Maria Theresa as a private collection. The public were admitted only on certain holidays and then never inside the houses. Hence the houses are small and most of the animals can only be seen outdoors in good weather. The gardens, which are adjacent to the magnificent Schönbrunn Palace grounds, are beautiful and well arranged.

The collection is rich in rarities, due chiefly to the efforts of a Viennese banker, Mr. Weidholz, who has made several collecting trips to West Africa. Of the three giraffes, one came from Senegal. There are three West African lions, a pair of red buffalo, and no less than 18 species of African antelope including the West African kob and the horse antelope, and two male hyena dogs. Many interesting animals were born in the zoo, including an Indian elephant, a great ant-eater, and Arabian and Dorcas gazelles.

BUDAPEST (A. Czerba, in charge)

Just inside the entrance to the Budapest zoo roads radiate in four directions and there is a beautiful floral display. The monkey house is excellent; all cages are lighted from the top and the inside cages are protected from the public by glass placed six inches from the bars. Two lion marmosets are kept in a glass-fronted cage, where they are given extra heat from electric light bulbs. After six months of captivity they were in excellent condition.

The arrangement of open pits for lions is unusually good. The ground slopes in front away from the visitor, so that he loses all idea of a pit, and feels as though only a narrow strip of grass separated him from the lion. In the pachyderm house the bathing pool is



FIG. 47.—Waterfowl pond, Budapest. Specimen of magnificent artificial rock work.

heated by natural hot water from springs 2,500 feet below the ground. This house is unusual in that the cages are arranged like grottoes, lighted from above.

The beautifully decorated aquarium is maintained by an extra admission charge of 8 cents, most of which is used to buy new stock. The excellent collection of reptiles and tropical fish are kept in a converted palm house. The bird house, though not very large, appealed to us as the best we had seen. At one end is a glass-enclosed panorama with a pool and rock work, housing avocets and shore birds.

The zoo maintains a large farm outside the city where much food for the animals is raised. An interesting feature of this zoo is that most of the employees live in a large apartment house at one side of the park.

COPENHAGEN (Director, Th. Alving)

The Copenhagen Zoo was founded by a private society and organized as a stock company. Its income is something over \$100,000 a year, and its attendance 400,000. The 18 acres of this park are well laid out and beautifully cared for, and are adjacent to a large public park. It has a good collection.

The new monkey house has several unique features. The ceiling and walls in the visitors' part are black. The cages are lighted from above, and one entire side is a conservatory, separated from the public by glass, and containing large cages for the great apes. These cages have oak parquet floors imbedded in asphalt. Vita-glass is to be installed in the hospital and receiving cages. On the outside of the building is a row of conventional cages, but at either end is a barless pit backed by the building, inhabited by baboons and mangabeys.

Chief among the animals is the female Indian elephant, now, very old, but distinguished for having borne three young in captivity.

ANTWERP (Director, Dr. Michel L'hoest)

This is one of the older zoos, and the most convenient of all for the tourist, as the entrance adjoins one side of the railroad station—in fact the station serves as part of the boundary of the zoo.

The buildings are very large, with a great deal more space than is usually provided for the visitor; some of them are beautifully decorated. The aquarium and reptile house are together. There is a "laiterie," a large room with tables where milk is served. The cows, each one pedigreed and named, are kept in the same building separated from the public only by a glass partition.

The collection is one of the most remarkable that we saw. The only okapi in captivity had been in the zoo for six months. This animal stood about four feet high at the shoulders, was very tame and in fine condition. Nearby were two giraffes from the Lake Chad country, kept behind glass, and an elephant from the Congo, one of the herd that has been domesticated in the Katanga as work animals.

Antwerp has the only shoebill in any European zoo. The collection of raptorial birds was the finest that we saw in Europe.

AMSTERDAM (Director, Doctor Sunier)

The Amsterdam gardens, opened in 1838, are the third oldest in Europe. This is a healthy zoo for directors, for during the past 91 years there have been only three directors, including the present in-



FIG. 48.—Dr. Sunier and his tame aardvark, Amsterdam.

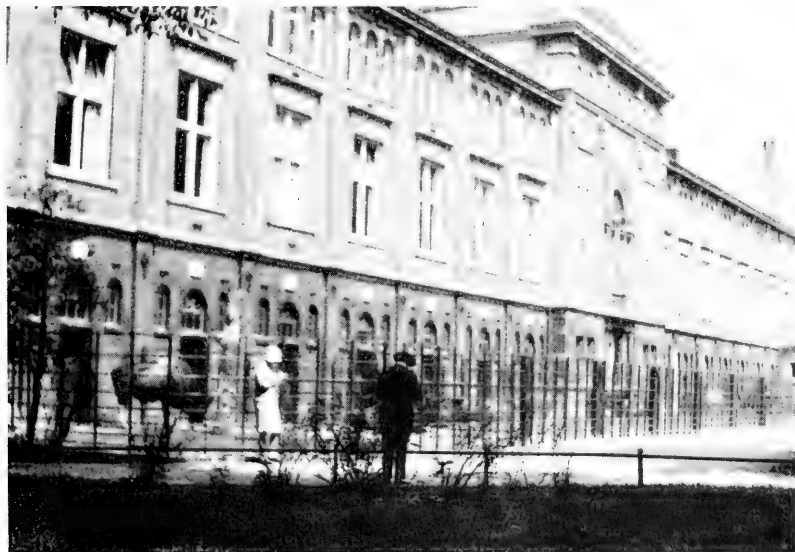


FIG. 49.—Wild cattle house, Amsterdam. Rooms in upper floor used as laboratories by university students in zoology.

cumbent, who is a comparatively recent arrival. The zoo is maintained as a private society, and it has some private endowment. The university and the zoo cooperate, and a large zoological laboratory is maintained on the upper floors of the wild cattle house. We visited the laboratory and saw the university students working. It was interesting to find zoology being studied in a zoo.

The buildings are large and good, though old; the collection is superb. The group of wild cattle is the best that we saw. Among the breeding animals are anoas, gayals, and Sumatran wild boars. Among the rarities were the ai-ai, which has lived there since 1914, and a *Tomistoma* from Borneo; an aardvaark, which has now been in the collection for three years, is so tame it will come when called and enjoys being petted; Javanese otters; and a manatee. The manatee has been in the zoo for a year, living in a large tank closed above with glass. Both the water and air are kept at a temperature of 80 degrees. The animal is fed lettuce, and according to the director, costs 3075 guilders a year to maintain.

A new open air lion pit, now under construction, will have a cement background planted on top with greenery. The aquarium is unusually good. We noticed a school of herring, which are not common in aquaria because, it is said, at night they bump into the rocks and kill themselves. These have been provided with a night lamp and as a result are the only successful school of herring in any aquarium. A pair of sterlets (*Acipenser ruthenus*) have been there for 47 years.

ROTTERDAM (Director, K. Kuiper)

This zoo was established in 1857 by three amateur zoologists. The park itself is flat, but splendidly laid out with gardens and good buildings. European blue herons nest here annually, many trees in the park having a dozen or more nests in each. The great flight cage for outdoor birds was one of the most attractive that we saw in Europe, and the splendid sea-lion pool, built at a cost of \$40,000, had a water fall at one end.

The collection contains upward of 2,600 animals, many of them gifts to the society. Among the notable exhibits were three specimens of *Felis minuta*, the little tiger cat from the East Indies, and a cage of Australian bush turkeys.

EXPLORATIONS IN HAITIAN CAVES

BY ARTHUR J. POOLE,

Aid, Division of Mammals, U. S. National Museum

During the past few years several expeditions from the Smithsonian Institution have visited Haiti with the purpose of exploring the numerous caves for the bones of extinct animals and birds, and also to make general biological collections, principally birds and reptiles. The present expedition is a continuation of biological explorations in Haiti made by Mr. Gerrit S. Miller, Jr., Curator, Division of Mammals, U. S. National Museum, in 1925, Dr. Alexander Wetmore, Assistant Secretary, Smithsonian Institution, in 1927, and the writer during the winter of 1927-1928. This expedition, as well as the one during the winter of 1927-1928, was made possible through the generosity of Dr. W. L. Abbott.

Accompanied by Mr. Watson Perrygo, taxidermist's preparator, U. S. National Museum, I left Washington December 8 for New York City, and from there sailed on December 11 on the S. S. *Cristobal* for Haiti. On December 20 we arrived at Port au Prince, and left there a few days later for St. Michel, about 150 miles northward by auto, where we were made welcome at the home of Lt. Barwick, our headquarters in the St. Michel district. On the 27th work was started in one of the caves of the Atalaye group, and after a thorough examination of this cave, with no results, we discovered two new ones that had not been worked before. Both of these were somewhat similar to one just examined, in that we had to use ropes to lower ourselves to the floor, a distance of about 20 feet. In the larger one there was an additional incline of about 20 feet which was covered with surface soil. At the base of this incline, the cave opened into a long chamber, about 100 feet in length, with several chambers of small size opening from the main one. The ceiling was quite low, from 8 to 12 feet and, therefore, we saw but few bats. We excavated in numerous sections of the floor, which consisted principally of guano, but found few bones, chiefly skulls of living forms of bats and a series of jaws of a small extinct insect-eating animal (*Nesophontes*).

In one section of the cave was a huge pile of guano, about 15 or 18 feet in height, and upon closer examination we found there was a small crevice about a foot wide and three feet long at the top of the



FIG. 50.—Presidential palace at Port au Prince. The street in the foreground is named after Lindbergh.



FIG. 51.—Native market scene at St. Michel. The bulk of the articles for sale are laid out on the ground. The articles are carried back and forth each day from the native's home to the market place.

guano heap. We had noticed the peculiar clicking sound made by bats but had seen only a small number clinging to the ceiling of the cave, so we decided to investigate more thoroughly the source of the noise. We crawled carefully up the guano heap toward the crevice, and when within about two feet of the hole, noticed a great amount of heat coming through the opening, together with very strong ammonia fumes, and we could hear the swishing of large numbers of wings. Perrygo and I placed our electric lanterns through the opening and turned them on. Immediately there was a terrific noise resembling that of a hurricane, and bats flashed past our heads by the hundreds. Beyond this tiny opening was concealed another cave or chamber as large as the entire outer cave, and in it were hundreds of thousands of bats. A few hours later, after the bats became quiet again, we took another look at them. It was a wonderful sight. As far as the rays of the electric lantern would carry, great masses of bats could be seen clinging to every available inch of ceiling and walls, some of these masses being as large as a bushel basket, while thousands were in flight. From observations and specimens taken, only two species appeared to occupy this great roost. Four days were spent working this cave.

On January 10 we started work in a large cave near San Rafael which had been partially worked during the previous season. Four days were spent here with fair results, a fine series of jaws of the small insectivorous animal being obtained.

Two days were spent working in a large cave situated about $3\frac{1}{2}$ miles southeast of Don Don. The opening was situated about 100 feet back from, and about 30 feet above, the river level, and although the cave appeared to be just the type to contain extinct mammal and bird bones, relatively small numbers of bones were found, these consisting chiefly of rats and bats.

Because our line of work was different from anything the people of this section had seen before, we were visited daily by hundreds of natives eager to watch our every move. The consequence was, that we were unable to give proper attention to the preparing of our collection. At San Rafael and at Don Don, among our various collections, we had taken five live snakes, commonly known as tree boas, which we kept in a large gunny-sack. Knowing the natives greatly feared snakes, and believing it would keep them away from the door so that we might get enough light to work by, we hung the bag on the guide rope attached to the front of the tent. It did not take long for one of the natives to discover that the bag contained live snakes, and although temporarily it kept them away from the entrance, the news



FIG. 52.—Type of native boys employed in cave work. Although their clothes are somewhat tattered and torn, while at actual work in the caves these are sometimes removed in order to preserve them.



FIG. 53.—Entrance to the largest cave of the St. Michel group. Although the entrance is but a few feet in width and height, the cave is about 150 feet in length by from 60 to 80 feet in width, with the ceiling ranging from 15 to 50 feet in height.

spread rapidly to the village and countryside, the consequence being that we thereafter had about three times as many visitors as before we produced the bag of snakes.

On January 20 we broke camp and started overland for Grande Rivière, and from there by train to Cape Haitien, where we remained for several days purchasing supplies and making necessary arrangements for the following month's work. On January 26 we left Cape Haitien for Fort Liberté, the old French capital of Haiti, situated on the northern coast about midway between Cape Haitien and the Dominican border. The present town of Fort Liberté is but a skeleton of what it once was; at every turn and on every street may be seen tumbled-down ruins of once beautiful buildings and fine homes. Between the town and the narrow entrance to the bay, a few miles distant, are a number of old French forts, at one time the powerful protection of the French capital of Haiti. Even today these forts are almost intact, strong high walls bordering the edge of the bay, with small openings every few feet for the projecting muzzles of the cannon. In the interior are the old powder magazines, wells for the supply of drinking water, and passageways to the various sections of the fort.

At 7.45 one evening we finally set sail for the Seven Brothers Islands in a native-made sail boat about 20 feet in length and with a single sail. As we planned to spend several weeks working on the various islands, our small boat was well laden, with its crew of two, our native cook, and Perrygo and myself, together with our food supplies, fresh water, and camp equipment. At about 3 a. m. we arrived at Tororu Island, and after remaining on the boat until day-break, we landed to make investigations. This island, was, like most of the group, very small, and contained only a few trees and bushes, a rather heavy growth of coarse grass, and a small variety of cactus. Lizards were very numerous, some of which we collected as specimens, together with a few sand crabs and small birds. As we were walking along the sandy beach on the east side, one of the crew pointed to a spot that had been considerably torn up. Upon closer examination it proved to be the tracks of a huge sea turtle that had come upon the beach to deposit its eggs. The two men began digging carefully with their hands, their faces beaming with smiles. After pulling the sand away to a depth of about 15 inches, they found the eggs, and to our astonishment and the natives' joy, the nest contained 193, half filling a bushel basket. Monte Chico Island, some four or five miles to the northeast, we found to be almost a duplicate of the one we had just left. We spent a couple of hours here, during



FIG. 55.—Stalactite formations in the cave at San Rafael. These formations, one of which in this particular cave takes the form of an angel, known as San Rafael, are worshipped by some of the natives.

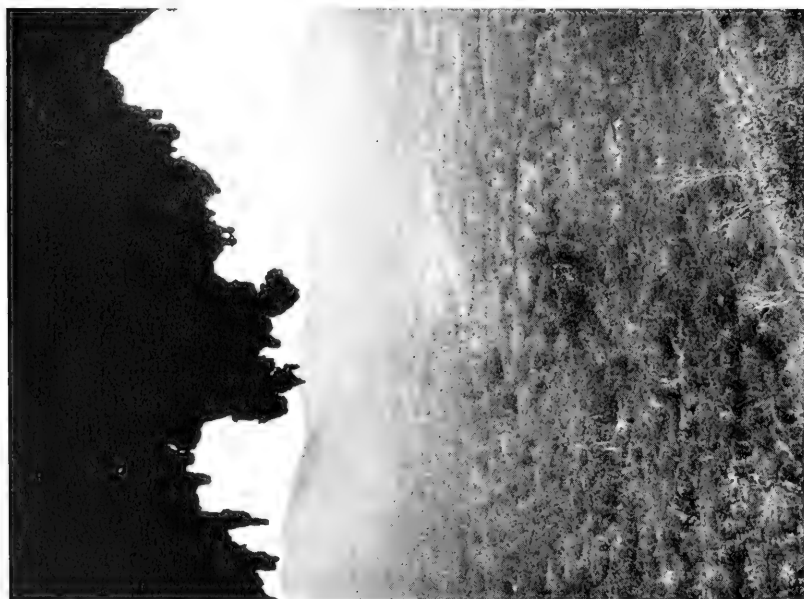


FIG. 54.—Native village of San Rafael taken from the interior of a large cave about two miles distant and about 1,000 feet above level of village.

which time we collected some small birds and lizards, the latter being very plentiful. We arrived at the tiny Muertos Island about mid-afternoon and soon started unloading the boat to make this our permanent base. This island is the smallest of the seven, being only about 400 feet long by 300 feet wide, very low, with sandy shores on all sides, the entire island appearing like a small sandbar, surrounded on three sides by coral reefs that protruded above the water during low tide. All the larger vegetation was in the center of the island, a fine place for a camp, as the trees were large enough for shelter and shade.

On January 30 we made an early start for Tercero Island, the second largest of the group, being about a half mile long by a quarter mile wide, completely encircled by a wide sandy beach. Here, besides an assortment of lizards and a few small birds, we were very fortunate in getting a pair of the rare oyster catchers. About 2 p. m. we decided to start back, and when we boarded the boat the crew appeared very talkative, somewhat nervous, and in a hurry, which was quite contrary to their usual mood. It did not take us long to learn the reason, for half a mile out from the lee side of the island we began to run into huge waves and by now the wind from the northeast was blowing a gale. From this point it was perhaps five miles to our island camp. Many times the bow of our small boat plowed through a large wave, soaking all of us and keeping both Perrygo and me bailing water. The crew were yelling orders to one another and to us, although at this time we did not understand what it was all about, but it looked as though we might be swamped at any moment. Finally we reached our tiny island, where six fisherman started out in one boat to help us. In a few minutes we were transferred to their boat, while some of them helped our crew get safely to the lee side of the island. The strong wind kept up all night, at one time almost carrying our tent away. All night long the waves pounding against the northeast corner of the island sounded like the roar of distant cannon, and at times the waves would break over the sandy rim of the island, but the water soon disappeared through the sand. As our supply of fresh water had been almost completely exhausted, we ordered the crew and cook to leave as early as possible for the mainland to fetch a new supply of water and some fresh vegetables. They left shortly after daybreak, the wind being favorable to get them to Fort Liberté in a few hours, and we expected them to return during the afternoon. I did not realize that our water supply had gotten so low until, starting to prepare breakfast, I found that it was less than two quarts. About noon the wind started blowing again and in a few hours reached gale proportions, as it had the day



FIG. 56.—Our camp at Don Don. It was here that the natives, through curiosity, came to visit us in such large numbers that we were unable to continue our work and were practically forced to leave this location.



FIG. 57.—Don Don, a beautiful and picturesque native village, rich in coffee and fruits. The prosperity in this section is evidenced by the metal roofs on the native houses. The "main street" was formerly the old French road that extended from Port au Prince to Cape Haitien.

previous, and the gale continued five more days. Fortunately it rained very hard for several days, supplying us with an abundance of fresh water. It was not until Sunday morning, February 3, that our crew managed to get out to our island. They had been sailing for two days and nights trying to reach us, and when they finally managed to make a landing, they were completely exhausted.

After visiting three more of the islands, we returned to Fort Liberté, and from February 6 to 20 our entire time was given to the collecting of birds. We made several short trips out of Fort Liberté in the same little sail boat we used on our island trip, with excellent results. During this period we made a collection of 163 bird skins and 39 bird skeletons, together with a number of bats, lizards, fish, mollusks, and miscellaneous material. Our next objective was the Island of La Gonave.

At 9 p. m., February 27, we left St. Marc in a sail boat, somewhat larger and of much better build than the one we had in the north, with a crew of two men. About midnight the moon rose and at this time we were but a few miles out from land. The wind had ceased entirely, and the crew had stopped sculling, stating that it would soon blow again. About 1 a. m. our attention was attracted by a peculiar sound, like the "blowing" of porpoises. We paid little attention to it, believing it to be a school of porpoises going by, but we soon heard it again, this time but a short distance away, and much to our surprise, we saw plainly in the moonlight, a large whale not more than 500 feet from our boat. The next "blow" came from the opposite side of our ship, about the same distance as the one we had previously seen on our right. The tactics of appearing, blowing, and then disappearing, continued for a few minutes, when to our amazement, one appeared on each side of our boat. The crew paid little attention to them, but the rest of us began to feel somewhat uneasy, having a whale bobbing up and down so close to us on each side. A few minutes later we could see and hear three whales, apparently playing or feeding near the same spot. This continued for about a half hour, when they all seemed to make a deep dive at the same time, their tails being high out of the water as they went down, and this was the last we saw of them.

At 6 p. m., 21 hours after leaving St. Marc, a distance of 22 miles, we arrived at Anse á Galet, the Gendarmerie Headquarters for the Island, where the only American, an officer of the Marine Corps, was stationed. From Anse á Galet we traveled overland to En Café, and on March 4 investigations were begun in a group of caves that we located about a mile from our camp. The first one to be worked was



FIG. 58.—Method of holding and carrying children at En Caf , Island of La Gonave. The little fellow carrying the baby would appear about every other day minus his shirt. When asked what became of it he informed us that it was "wash day."



FIG. 59.—Native church at En Caf , Island of La Gonave. Note poles for seats, lumber being very scarce here. The natives come from miles around to these meetings, sitting for hours on the pole-seats.

the largest of the group of six, and here we obtained a small amount of the extinct animal bones, and a considerable amount of human remains. Perrygo, in the meantime, was making a collection of birds from this and nearby localities. Two days more were spent in completing the largest cave, which was somewhat disappointing from the standpoint of material, considering its size. All of the extinct material was found in the entrance and none in the cave proper, which was about 100 feet in depth by about 50 to 60 feet in width. The following four days were spent completing this group, with but fair results. On the 10th both Perrygo and I spent the entire day on bird work. The following day we shifted operations to a large cave about $2\frac{1}{2}$ miles to the northeast. Two days were required to complete the work here.

Each day while working in this section, we could hear the strumming of native drums and, on many occasions, would see small processions of both men and women marching over the hills and through the valleys, usually with a leader carrying two flags, one red and one white, a drummer, a native shaking an instrument that resembled a large rattle, consisting of a long stick with a can attached, partially filled with stones or other objects. Sometimes there would be a man blowing a long bamboo flute that emitted a rather weird or mournful tone, and occasionally conch shell horns were added to produce noise. We had heard many rumors in connection with these daily parades and were of the opinion that they were staged for no good purpose. On the night before we broke camp, a "parade" was started about dusk. We could hear the drums and other instruments, together with the almost incessant yelling, or perhaps singing, of the natives. At first it was far away, although we could tell from the increased volume of noises that they were constantly moving and apparently gathering more members of their clan. Just about as we were ready to retire, we noticed the sounds getting more and more distinct, coming in our direction. We had only a short time to wait before they were passing within a few feet of our tent, the music now being in great volume, and, by the aid of a few torches they carried, we could see that they were constantly dancing. At first we were somewhat alarmed as the procession by now had reached enormous proportions. However, we remained in or near our tent, and finally the parade passed on, but not for long. An hour or so later it returned, stronger than ever, and this kept up until long after daybreak. That morning we packed our outfit on the burros and made ready for the long trip back to Anse á Galet. As we were leaving we were informed that the all-night parade had been staged in our honor, which caused us

to feel much relieved. The results of this trip, besides our cave material, were a fine assortment of small birds, 79 skins, 42 skeletons, together with a few bats.

On the morning of March 14 we left La Gonave for St. Marc, and left there at daybreak the next day on the express for Port au Prince, which consisted of a motor-driven engine and one passenger coach. Our next trip took us to Cerca La Source, some 30 miles to the east of Hinche, and near the Dominican border. We camped about 5 miles out from the village, near a large cave that we were to investigate. This cave was somewhat different from any of the others we had worked in. It had two entrances of about the same size, one opening on the south, the other on the east, and but a few yards from one another. The slope from each entrance to the base or floor was quite steep, being about 30 feet in depth. The two passages joined at the floor level of the cave. The main chamber was circular, about 25 feet in diameter, with low ceiling, and no signs of either stalactites or stalagmites such as we had found in most of the other caves. From this central chamber ran five tunnel-like, long, narrow passages, two toward the south and three toward the north. The two southern passages were carefully explored and found to extend about 75 to 100 feet, narrowing considerably at their terminus, and both with low ceilings. One of the northerly passages was almost a duplicate of the two just mentioned while another rose quite abruptly and came to an end at a distance of about 50 feet. The fifth one, we were unable to explore fully. In all the passages a few small bats were seen, either clinging to the low ceiling or flying about. In order to get into the fifth or last chamber mentioned, we were compelled to climb over an enormous bank of bat guano, some 15 or 18 feet in height, which all but obscured the entrance. After we passed beyond this guano heap and had traversed the narrow passageway for some 30 or 40 feet, we felt as if we were walking into an oven, the heat being terrific, and the ammonia fumes so strong that it was almost impossible to breathe. Bats were flying about us in great numbers, hitting us on all parts of the body, as the passageway had now become a mere tunnel about 3 feet wide and 4 feet high. With the aid of electric lanterns, we could see, perhaps 30 or 40 feet farther back, what appeared to be a solid mass of bats. We finally were forced to return to the outer chamber and fresh air.

We had noticed on the previous evening, at dusk, that thousands of bats suddenly appeared among the trees and around our house, and continued to come for quite a period of time. On the following day, we discovered the enormous bat colony in the cave, so decided



FIG. 61.—Woodpeckers and parrakeets nesting in royal palms at Cerca La Source. The woodpeckers originally make the nests, some of which are later taken over by the parrakeets. Bats also roost in some of the abandoned nests.

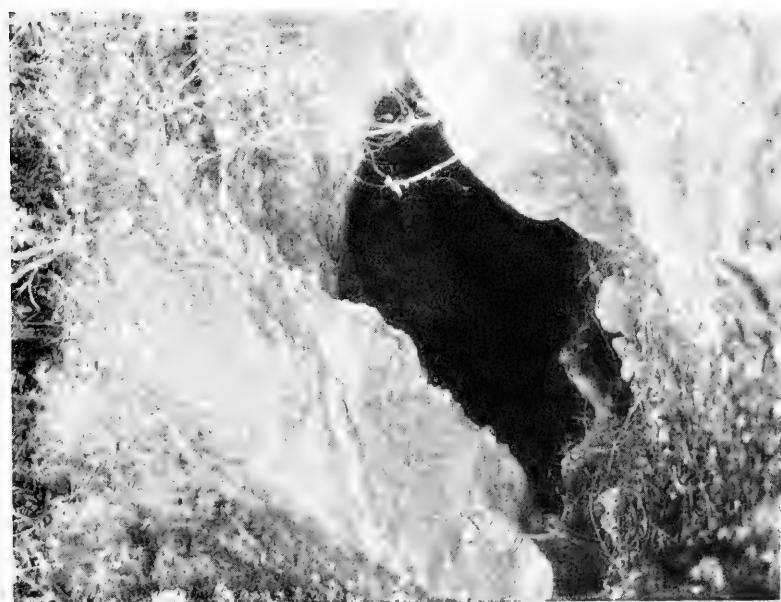


FIG. 60.—Entrance to cave containing enormous bat colony at Cerca La Source. Every evening at dusk hundreds of thousands of bats come out of this cave in such dense formation that, from a comparatively short distance away, they resemble a cloud of smoke.

to watch them make their exit that evening. At 5.45 p. m., Perrygo and I stationed ourselves near one of the entrances. In about ten minutes a half dozen bats came out of the inner chamber, flew to the edge of the entrance, and then returned. This was repeated several times, each time with an added number of bats. Then one or two flew beyond the entrance, circled, and returned. By this time the entrance was a seething mass of bats, although they were not, as yet, flying away. Suddenly we heard a roaring, swishing sound, and immediately, as though by a given signal, they came out of both entrances by the thousands, flying away in all directions at great speed. The natives were very superstitious about this cave, and, shortly after our arrival, told us that sometimes, just at dusk, smoke came pouring out. Undoubtedly the "smoke" they referred to was the dense clouds of bats, which, at a comparatively short distance, resembled smoke.

On March 29 we left Cerca La Source for Port au Prince, where the rest of our time was utilized in the packing and shipping of our material to the National Museum. On April 3 we sailed aboard the *S. S. Ancon* for New York.

The success of the expedition was due largely to the courtesies extended by Dr. G. F. Freeman of the Service Technique, who furnished transportation facilities on several occasions; General Russell, American High Commissioner; Generals Evans and Ramsay of the Guard de Haiti, who assisted us in many ways; and the U. S. Marine Corps.

BIOLOGICAL COLLECTING WITH THE U. S. NAVAL
OBSERVATORY ECLIPSE EXPEDITION
TO THE PHILIPPINE ISLANDS.¹

By DR. HENRY C. KELLERS,
United States Navy

While on duty with the U. S. Marine Corps in Nicaragua, I received a radio early in January, 1929, detailing me to accompany the U. S. Naval Observatory Eclipse Expedition to the Philippine Islands as representative of the Smithsonian Institution. I left Nicaragua January 10, and eleven days later arrived in San Diego, California, where I gathered together the collecting equipment which had been sent out for me by the U. S. National Museum, and joined the eclipse party on board the U. S. S. *Henderson*, which sailed for Manila January 26. After a pleasant voyage across the Pacific, stopping at Honolulu and Guam, we arrived at Manila, February 19, where the party was met by Father Selga, Director of the Manila Observatory, who had during the previous year prepared interesting maps and astronomical and meteorological data indicating the conditions likely to prevail at the time of the eclipse; also a summary of the housing facilities, hygienic conditions, and accessibility of the places in the path of totality, which were of great value to the astronomers and also to me as biologist of the expedition. After remaining two weeks at Manila, we left March 5 on the U. S. *Penquin* for Iloilo, Panay Island, arriving there March 9. This gave me exactly 8 weeks to do collecting before the eclipse which took place on May 9.

Iloilo is the second largest city of the Philippine Islands, in population as well as in commerce. We spent several days in visiting various places and examining sites on which to erect the astronomical instruments and cameras. It was decided at last to occupy the grounds of the Philippine Railroad at Lapus, which was just across the Iloilo River from the City and connected by a ferry that ran unceasingly day and night at one centavo a trip in the daytime and two centavos at night. The president of the railroad offered to us all the facilities at his command, including the use of the machine and work shops

¹The Smithsonian Institution is greatly indebted to the Navy Department for its cooperation and courtesy in designating Lieutenant Kellers, the medical officer of the Eclipse Expedition, as special representative of the Institution for the purpose of collecting natural history material.



FIG. 62.—The astronomical camera, so large that two operators sat inside to change the plates during the eclipse. (Photograph by Kellers.)



FIG. 63.—My collectors working at low tide. (Photograph by Kellers.)

and storage space, and for me a large room with electric lights, running water, tables and shelves, for use as a laboratory.

I have found that in collecting in foreign countries and among primitive people one of the first requisites is to court the friendship of the natives. If one does not speak the language or dialect, he should compile a small vocabulary of words and phrases to carry around with him, such as, "I want," "Bring me," "Let us go fishing," etc., and adding to these simple phrases the native name for the various specimens that one is after. I have found that the fewer words used, the better the natives understand, as they soon learn that you are collecting the various classes of fauna indigenous to the locality. One of my most useful collectors turned out to be the ex-president of the non-Christian tribes of the island of Panay; the faithful old fellow came walking down to the wharf with two large monitor lizards, hog-tied and hanging over his shoulders, just as the expedition was leaving Iloilo on the steamer for Manila after the eclipse. These were brought safely to the National Zoological Park in Washington. A couple of pesos were thrown to him, and he was all smiles as we sailed away.

When we were settled, collecting started immediately. Daily hauls of the 40-foot seine were made on the beach at various stages of the tide. Natives were sent out with the smaller seine to the fish ponds for specimens that could not be obtained elsewhere. I hunted daily for reptiles but although the country appeared to be good collecting ground, few were obtained. After questioning the natives, I found that it was necessary to get up early in the morning an hour or so before sunrise, and upon going over with a flashlight or lantern the same ground that I had covered the previous day, I found numerous snakes out foraging for their breakfast. Like the natives, they retire during the heat of the day to the shade and dense thickets and can not be found.

Traps were set around the various barrios and in the swamps and jungle for whatever we might get. Numerous giant lizards were captured, as well as live pythons, birds, and monkeys, and also a number of civet cats which were brought back alive to the States for the National Zoological Park. Tow-net hauls were made at various stages of the tide in the Iloilo Straits for both diatoms and crustacea. Several trips were made to the caves on the Island of Guimaras, which produced good results in bats and land shells. Collecting was carried on at Capiz on the northern end of the Island, and also on the Island of Negros and Cebu.



FIG. 64.—Typical Nipa house of the natives. (Photograph by Kellers.)



FIG. 65.—Typical rural scene in the Philippine Islands. (Photograph by Kellers.)

All primitive people have a natural history nomenclature, which is generally unsatisfactory from a scientific standpoint owing to dialectic divergencies, and the Filipinos are no exception. One of the peculiar and interesting native names that seemed to be the same in all of the dialects I encountered was the name "walo" for the black banded water snake, common in the adjacent waters. The word "walo" in Visayan and Tagalog dialects means "eight." The natives have the idea that when a person is bitten by one of these reptiles, if he does not die in eight minutes, he will live for eight hours; if still alive after eight hours he will live eight days; after eight days, eight weeks; and if he is still alive at the end of eight months, he is out of danger. I endeavored to learn of a case of poisoning by these snakes but was unsuccessful. Although poisonous, they are not pugnacious, and when they get tangled in the fishing nets, the fishermen pick them up by the tail and throw them out into the water.

As the date for the eclipse approached, the natives of the rural districts and even those of the city became rather nervous about the event, and made black and white crosses on their houses. I was invited by the president of the Philippine Central College at Jaro to address the pupils on the subject of the eclipse and allay their fears, and the same talk was requested by the superintendent of the normal school of Iloilo. Three thousand children were reached by these talks, in which I also told of the work that I was doing in collecting the animals, birds, and reptiles of the island. As a result of this, it was necessary to work late at night for days preserving and checking over the specimens brought in by the children.

Fish traps along the shore were visited from time to time and valuable material collected. The markets were visited regularly on market days, and when the native tradesmen came to know what I desired, they would often have ready for me quantities of valuable material, which otherwise it would have taken months to procure.

Much has been written on the Philippine Islands and its people, but a few impressions may not be out of place. At present the schools are overcrowded, 50,000 pupils being enrolled last year in the Province of Iloilo. English is taught in all the schools, but many generations would be required for it to become the universal language, for the children on going home after school immediately revert to their native dialect. Quoting from the introduction of an English-Visayan dictionary compiled by Señor Jose Ma. Cuenco, Ph. D., after his many years in the profession of teaching, "I am convinced that many of my pupils of the advanced English classes have vague, misty ideas about the most common English words." After completing the lower



FIG. 66.—The damp trackless forest of the Islands. (Photograph by Kellers.)

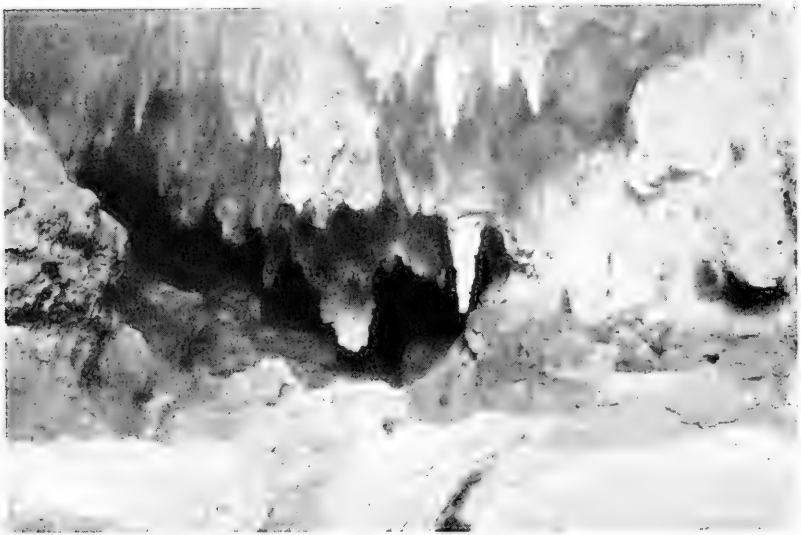


FIG. 67.—Stalactites in caves on Guimaras Island, where many bats and land shells were collected. (Flashlight photograph by Kellers.)



FIG. 68.—The fast sailing double outrigger canoes of the Filipinos.
(Photograph by Kellers.)



FIG. 69.—Carabao hauling wood on a primitive sled. This animal can be led by a native child but hates the Caucasian race. (Photograph by Kellers.)

grades and going through high school, the young Filipino's ambition is to go to one of the overtaxed universities and become a scientist or professional man, especially a lawyer. What benefits this higher education will have for the Filipinos time alone will tell.

The national drink of the Filipinos is the liquid known as "tuba." It is not as generally thought the fermented milk or water of the cocoanut, but the fermented sap of the tree. The trees set aside for tuba extraction are not allowed to produce nuts. The buds are cut off and the fruit bearing stalks incised, the end being inserted in a hollow joint of the bamboo called a "bombon." In the bottom of the bombon is placed a very little of the powdered Tonga bark (*Rhizophora longissima*) to give the tuba a reddish color and to counteract the laxative effects of the sap. Fermentation starts almost immediately after the sap begins to flow. The tuba-gatherer carries on his back a large joint of bamboo in which to put the sap collected from the bombon, a swab made from a piece of bamboo to clean the bombon, a cocoanut shell with the powdered bark, and a crescent shaped knife to slice the end of the stalk. The tree is tapped twice a day—once at about sunrise and again in the afternoon; the sap flows freely for about two hours, then stops until tapped in the afternoon. The tuba-man easily disposes of his morning and evening draught, which is palatable and stimulating.

Of the animals of the Philippines the carabao may be considered the most useful. An unwritten law of the land is that a carabao has the right of way on all roads, even the railroad trains being stopped when the engineer sees the carabao crossing the track ahead, for one never knows what the beast intends to do next.

The National Museum informs me that the collections brought back by this expedition are of particular value to them in supplementing the earlier marine dredgings of the U. S. Fisheries Steamer *Albatross* in Philippine and adjacent waters in 1907-10. The work of that vessel was principally in the deeper waters of the region, while my collecting, by reason of its field of action, was primarily littoral in character and rounded out many of the series of Philippine invertebrate marine life in the national collections. The expedition illustrates the advantages which may accrue through cooperative arrangement between two branches of the Government service. The Museum officials were highly appreciative of the cooperation of the Navy Department, which resulted in obtaining valuable natural history material amounting in all to some 14,500 specimens of mammals, birds, reptiles, fishes, crustaceans, insects, mollusks, and other forms.

EXPLORATIONS OF THE REV. DAVID C. GRAHAM IN SZECHUAN, CHINA

By HERBERT FRIEDMANN,
Curator, Division of Birds, U. S. National Museum

For some time the Rev. David C. Graham has been planning a collecting expedition on behalf of the Smithsonian Institution to the Moupin district in Szechuan. Moupin was first explored zoologically by the Abbé Armand David, but owing to the difficulties to be overcome in getting there, and the remoteness of the locality, it has been visited by but few naturalists since his time. Dr. Graham attempted to reach this celebrated spot last year, and, for that matter, had planned to go there several times in the last few years, but each time as he was about to start, some insurmountable obstacle, such as civil war or swarms of robbers, prevented his carrying out his designs. It was therefore a matter of great satisfaction, both to him and to the Smithsonian Institution, that the summer of 1929 witnessed the fruition of his plans and rewarded his patient efforts with success.

On reading his rough field notes, jotted down faithfully day after day when wearying marches and general bodily fatigue made writing an irksome though self imposed task, one is struck with the number and variety of mishaps, delays, disappointments, and troubles too numerous to list, that were the almost daily experience of Dr. Graham, and the successful completion of the trip is therefore a tribute to his zeal and perseverance in the face of discouragements that would have turned back many a less experienced traveler in China. Not only was the trip accompanied by the usual labor troubles with indifferent, stupid, and ignorant coolies, by petty but nevertheless, serious thefts of pieces of scientific equipment, but the whole expedition moved against a threatening background, first of mere angry rumors, later of more rumbling reverberations of war, the sort of semi-organized warfare that serves more to render travel dangerous to civilians than to the contending military groups. A few quotations from Dr. Graham's diary may serve to give some insight into the conditions under which he worked.

Thus, while still at his headquarters at Suifu, some six weeks before starting for Moupin, he writes that, ". . . the postmaster informed me that there is fighting near Su Chow, east of here, and that there has been fighting at Ichang. Letters are not getting through

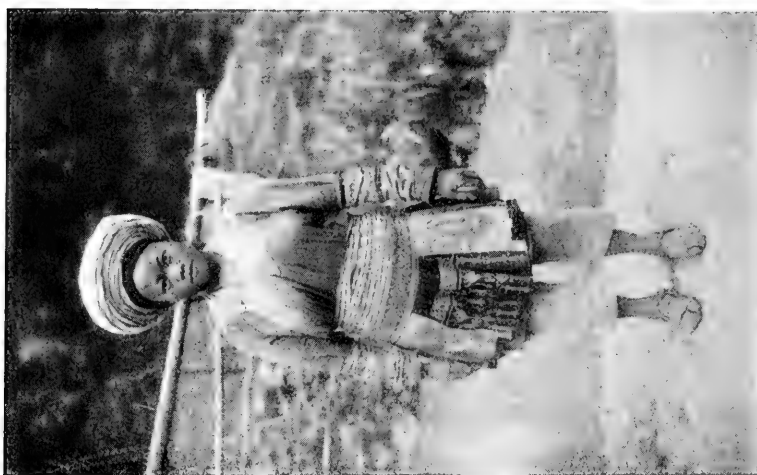


FIG. 70.—A typical Chuan Miao woman.
(Photograph by Graham.)



FIG. 71.—Chuan Miao aborigine women. The one at the left is dressed in a very elaborate and costly dress, worn by the well-to-do women of her tribe.
(Photograph by Graham.)

from Shanghai, so we have received no letters from America for at least a month . . . specimens cannot at present be forwarded, but must await the end of civil war in Szechuan. . . . I have gone over my ammunition, and find . . . I am shortest of the kinds which I need most. . . . This makes rather scant supplies for the Moupin trip, but with careful economy we can do with what we have. I will practically do no shooting until next summer so as to save my ammunition for the summer collecting." Three days later (April 28, 1929) he notes that, ". . . for over a month now, mail has not come through from Shanghai. It seems certain that neither ammunition nor photo supplies will reach me in time for the . . . trip."

As the time allotted for the trip was drawing near the difficulties seemed to increase. On June 6 Dr. Graham writes, ". . . I am building high hopes for the Moupin trip, but today some bad luck showed its face. I sent a messenger a few days ago to bring in my aborigine hunter, Yang Fong Tsang. Today he returned. A large band of robbers is operating on the Yunnan border between the home of Yang Fong Tsang and Suifu. They have looted several small towns. There is war between them and the militia. The messenger was unable to get to Yang Fong Tsang, and the latter may not get to Suifu for the Moupin trip.

"Another indication of bad luck is that there is drought in Kiating and at Yachow, which has doubled the price of rice. This will mean that some of our expenses are higher this summer."

Finally, after several vicissitudes of luck, good and bad, Yang Fong Tsang got through to Suifu, and on June 15 the party, consisting of Dr. Graham, five Chinese collectors, a military escort, and some 20 coolies, left Suifu, expecting to reach Moupin in 11 days. However, owing to unusual rains which made the paths muddy and turned what were ordinarily small streams into swollen torrents, it took eight days to reach Yachow and five more to reach Moupin.

Here the mountains ". . . and the hills are covered with forests and bushes. Nature has a much freer hand here than in most parts . . . and . . . specimens seem to be more abundant. . . . The town of Moupin is surrounded by high mountains. Near the town the vegetation is very poor . . . almost semi-arid. To secure much here, we will have to get off and work the high mountains that surround the town. The nearby hills are rather badly deforested." On the first day in Moupin Dr. Graham had the good fortune to procure, at the low price of three dollars in gold, a skin of the giant panda, a very rare large mammal unrepresented in the collections of the National Museum. It was however not a perfect specimen, as it



FIG. 72.—Trees and mountains near Suifu, Szechuan, China. The view is looking south near Tseo-Jia-Geo. (Photograph by Graham.)



FIG. 73.—Mouth of ancient Chinese cave, at Huang La Chi, Min River. (Photograph by Graham.)

lacked the claws, ears, and tail, but it was very welcome nevertheless. The giant panda is an animal distantly related to the bears and the raccoons. It is about the size of a small American black bear, but is remarkable for its color pattern. It is almost entirely white but has a large, black "saddle" mark on the upper back, black ears, and a heavy black ring around the eyes, giving it a be-goggled appearance. Very few specimens have ever been brought back to museums. Graham also procured specimens of the small panda, black and rich russet in color, and of the black monkey, both of which are very rare in collections.

Finding the immediate vicinity of Moupin rather disappointing, Dr. Graham decided to go to Yao Chi, a four days' march from there. The road to Yao Chi is exceedingly steep and rough, and the loads previously carried on poles resting on the shoulders of two coolies had to be rearranged and carried on the men's backs. The day after leaving Moupin the party ". . . had a great deal of trouble with the military escort. The first change of soldiers occurred about eight o'clock. We were to have ten soldiers, but were given only three, and were delayed fully two hours. The guns are muzzle-loading, and entirely innocent of any sights. The handles are rude, home-made affairs. We now have six soldiers with such guns, one of the soldiers being a boy about 12 years old. We were promised a bigger escort, but the soldiers failed to show up. One well-armed man could easily defeat the whole lot."

Ten days of hard, steep climbing after leaving Moupin brought the party well up in the mountains, their camp being at an elevation of 13,400 feet in the midst of forests of rhododendron and fir. Even here, in what one might expect to be uninhabited country, the expedition was not able to work in peace. Graham makes the following entry in his note book, ". . . I collected on a mountain east of Yao Chi and would have gone on to a higher and better hunting ground but the territory was infested with robbers. Today we almost literally stepped into a robbers' nest. I had hoped to work here two whole days and three nights but the robbers are too near, and we must clear out . . . tomorrow morning."

Going somewhat lower down, Graham came across, for the first time, fresh tracks of the giant panda, one of the chief objects of the trip. The "white bear" as he calls this animal, however, eluded him, but later on he purchased two more skins from Chinese hunters. Collecting of all sorts was carried on assiduously and the specimens received at the National Museum consist of mammals, birds, reptiles, amphibians, fish, and especially of insects. The butterflies and moths form, in themselves, a notable accession to the national collections.



FIG. 74.—Opium poppy fields in bloom in western Szechuan, China.
(Photograph by Graham.)



FIG. 75.—A Chuan Miao family near Tseo-Jia-Geo, south of Suifu, Szechuan, China. (Photograph by Graham.)



FIG. 76.—A Chinese memorial arch built across the road near Shü Kiang, Yunnan Province, China. (Photograph by Graham.)



FIG. 77.—View of the city of Moupin, Szechuan, China, looking eastward. (Photograph by Graham.)

The way back was just as arduous and strenuous as the journey out. The following incident is typical of the return march. ". . . Last night there was a very hard rain, amounting almost to a cloudburst. . . . This morning I heard that a creek ahead of us had washed away its bridge. There was no crossing this creek without a bridge. I said that we had a carpenter with us, and so we would build a bridge, and ordered all the coolies to bring along their loads and help. They were so confident that we couldn't build a bridge that they didn't come. It was five li from . . . where they were to the creek, and they thought they would have to carry back their loads to the inn again for the night. One of the coolies had the carpenter's saw. Although he was especially ordered to bring the saw along, he did not come. With no tool but the Smithsonian hunter's hatchet, the carpenter and I cut down trees and built a bridge across that roaring stream so . . . we . . . made our full stage today. Not a nail went into that bridge. It was done in a comparatively short time. The trees that made the foundation were tied tightly together by ropes of tree bark made by the carpenter. . . ." Two days later Dr. Graham got back to Moupin in the midst of a steady rain. The next morning (July 20) he left for Gan Yang Ba where he collected for four days, returning to Moupin on July 25. Inasmuch as Dr. Graham had to return to his mission school in August, the Moupin expedition had to be ended abruptly.

There has not yet been time to study the material collected by Dr. Graham, and the results of the trip cannot therefore be evaluated at this time. Many rare and desirable things were obtained, including two genera of mammals new to the museum, as well as many bird skeletons and skins. This brief account may well close with a quotation from Dr. Graham's notes, written immediately after the end of the journey. "In a way the Moupin collecting trip is a failure. In a way it is a real and genuine success. The Moupin district is too vast and rich to cover in so short a time. In the time available, I could have done better if I had known the country intimately. This trip is in a way a successful survey."

EXPLORATIONS OF DR. HUGH M. SMITH IN SIAM

By HERBERT FRIEDMANN,

Curator, Division of Birds, U. S. National Museum

During the past year Dr. Hugh M. Smith, director of the fisheries of Siam, has continued collecting in his spare time for the National Museum and, as in previous years, the material gathered has been of great interest and value. The specimens received at the National Museum this year total over 4,500, representing most of the major groups of animals and including some 400 plants as well. Among the more important lots are some 59 mammals, 663 bird skins and 10 skeletons, 205 reptiles and amphibians, 1,643 insects, 1,500 mollusks, and 158 miscellaneous invertebrates, especially crustaceans. The total collections of Siamese birds sent in by Dr. Smith now amount to about 3,000 specimens, one of the largest ornithological collections ever made in that country, while the mollusks received comprise one of the most important oriental collections of that group in the National Museum. The mammals collected are notable for the number of squirrels and primitive tree-shrews represented.

Inasmuch as no diary or photographs have been received from Doctor Smith, it is difficult to construct an orderly account of his travels, and until such data are forthcoming, the best we can do is to quote from his letters in chronological sequence. Writing from Bangkok on February 10, Doctor Smith announces the sending of a large shipment, especially of birds, ". . . from the mountains of northern Siam, and some from Doi Angka (or Doi Intanon), the highest Siamese mountain, where no previous zoological collecting had been done. Another lot is from Doi Sutep, near Chiangmai. . . ."

The latter mountain rises as an isolated peak from a flat plain about six miles west of Chiangmai. The first 1,500 feet of the slopes are sparsely covered with scrubby trees, but, at 1,700 feet this dry belt is replaced by dense, green forest.

"I am just about to leave for a long trip to northeastern Siam, where practically no collecting has been done in any zoological group. I go by rail to Korat, and thence by easy stages to the Mekong at Nong Kai and Vien Cheng."

Mr. Rodolphe Meyer de Schauensee has recently made two collecting trips to northern Siam in the interests of the Academy of



FIG. 78.—Long-tailed drongo,
Dissemurus paradiseus.

Natural Sciences of Philadelphia, and worked in the same general region as Doctor Smith. In response to an inquiry of mine, he has kindly sent me the following notes on the country.

"The whole of the part of northern Siam known as the Siamese Laos country is composed of flat circular plains, each divided from the other by mountain ranges, rising generally to an altitude of about 4,000 feet. The highest peak in Siam is Doi Angka, 8,400 feet. Streams are plentiful and lakes scarce. Bamboo is plentiful along the courses of these streams, and tall 'elephant grass' grows in all the abandoned clearings. Teak wood is abundant on the lower slopes of the mountains. However, I have never seen many birds in the teak forests. Trees on the slopes of the mountains to about 1,500 feet are small and the ground very dry and often stony. Above this the evergreen belt occurs, large trees and heavy undergrowth, in which bird life is most abundant. Hornbills, babblers, fairy bluebirds, nuthatches, bulbuls, make their home here. White-handed gibbons (*Hylobates lar*) are extraordinarily plentiful.

"This evergreen area reaches solidly to 4,000 feet where it gives way to a more open forest, carpeted with grass about two feet high, and the trees are smaller and covered with moss. Magnolias of the genus *Michelia* are very common. Sunbirds (*Aethopyga*) are always to be seen in them. Pine forests begin at about 4,500 feet, but birds seemed to be extremely rare in them. The only thing I recall ever having seen there is a drongo (*Chaptia*). Pheasants and partridges are common and certain babblers (especially *Sibiinae*) are confined to these top slopes."

Doctor Smith explains that as he was traveling on official business for the Siamese Government, his time for general collecting in the mountains was not as much as he desired, especially on Doi Angka, where he felt that he might have gotten birds new to his collection every day for a month or more. It is to be hoped that he will be able to make another and more prolonged stay there as his first visit resulted in the discovery of several interesting birds new to science.

On June 21 Doctor Smith writes that he plans another trip to the north in November, this time to the Kuhn Tan Mountains and the region north of Chiangmai. "Tomorrow I am going to Singora and . . . do some collecting . . . in that part of the peninsula where I, at least, have not collected birds." From a letter written on August 19 we learn that Doctor Smith's native collector had just returned from, ". . . a mountainous section northeast of Bangkok. He had a narrow escape from a huge wild boar which charged him while he was stalking some fire-back pheasants. The boar was not stopped by



FIG. 79.—Paradise flycatcher,
Terpsiphone paradisi.



FIG. 80.—The largest and smallest of Siamese woodpeckers. The woodpeckers reach their climax in Southeastern Asia, about 20 species being known from Siam. The large bird is Lichtenstein's woodpecker, *Mulleripicus p. harterti*; the small one is a piculet, *Sasia a. reichenowi*. The birds are one-third natural size in the figure.

charges of buckshot and No. 8 shot at short range, and the collector had to discard his gun and defend himself with his knife. After being chased around a tree for some time, the Dyak was finally able to get in a knife thrust, and the boar left, taking the knife with him."

Shortly after this, Doctor Smith sent his collector to a wild and isolated mountain region east of Bandon. On September 16 he writes that, ". . . a small collection is now in hand from a densely-wooded mountainous region southeast of Bandon in the peninsula. The place where the collecting was done is 17 miles inland, and the locality may be designated Sichol or Seechol (pronounced Seechon). . . .

"I am going this week to the . . . mountainous region close to the Tenasserim border. Very little zoological collecting has been done there. . . . During the coming winter, I am planning to make another trip to the mountains in northern Siam—this time north of Chiangmai."

It is rather premature to attempt any generalizations, as the extensive Siamese material now available for study has not yet been adequately investigated. The avifauna of Siam may, however, now be definitely said to be more closely related to that of India on the west, rather than to that of Indo China and the Malay States on the east, although, as might be expected from the intermediate geographic position of Siam, it shows many features of both.

The last lot of birds received from Dr. Smith contains several species previously unrecorded from Siam and a number of others new to the national collections, the most striking of which are a large ground cuckoo, *Carpococcyx renauldi* and a large horned owl with a powerful, heavy bill, *Huhua nipalensis*.

EXPLORATIONS FOR MOLLUSKS IN THE WEST INDIES

BY PAUL BARTSCH,

Curator, Division of Mollusks, U. S. National Museum

In continuation of the West Indian explorations for land mollusks begun last year under the auspices of the Walter Rathbone Bacon Scholarship Fund, I embarked on June 12, 1929, on the U. S. naval transport *Kittery* at Hampton Roads, Virginia, for West Indian ports. Through the assistance of Commandant C. S. McWorther of the U. S. Naval Station at Guantanamo, Cuba, I was provided with two splendid mounts and an able guide ready for an overland journey upon our arrival June 17, to Boca del Yateras, one of the classic type localities of Gundlach and Wright. Its inaccessibility has kept it from visitation by other naturalists since their days of collecting, and I felt that this opportunity which brought me within some 17 miles of the place as the crow flies must not be missed.

As the crow flies however, is not the method of eastern Cuban travel today, and shortly before midnight, when we again arrived at the naval station, we had covered 67 miles on slender trails over hills and dales midst thorn brush and palms frequently completely choked with epiphytes. Our weariness was offset by the knowledge that our kit contained the topotypes of the land shells which we have wanted for a long time.

On June 19 we reached Port au Prince, Haiti. Here Dr. S. S. Cook, Service D'Hygiène, carried me over our collecting grounds of long ago and gave me an opportunity to see what changes had taken place in the Cul de Sac region since 1917. Dr. Freeman, Director General of the Service Technique, arranged for an automobile which during the next two days carried me through the valley of the Artebonite northward through the magnificent Cibao range of mountains to Cape Haitien over the newly completed highway that connects these two ports. This trip carried me over territory in Hispaniola not previously visited by me and enabled me to make collections at many new stations from which no material had reached our Museum before. I regained the *Kittery* on June 21 and two days later arrived at San Juan, Porto Rico.

June 21 to July 10 were spent hunting for a suitable sailing vessel which could be hired to reach the islands that form the rim of the



FIG. 81.—The schooner *Guillermito*, which carried us around the rim of the Caribbean.



FIG. 82.—A shore view on the northeast end of Porto Rico. The coconut trees contributed to our catch of mollusks.

Caribbean Sea. The visitation of last year's destructive hurricane had materially reduced the number of schooners and those not lost were mostly securely hauled high and dry in protected places to render them safe against another blow. Then too, few skippers cared to visit what most of them termed the birthplace of hurricanes during the hurricane season—the wet season about to begin. It should be remembered that the rainy season is the only time when successful land mollusk collecting may be undertaken for during the rest of the year these animals estivate, tucked away in rock crevices or holes in trees or even buried in the ground from which they may be obtained in small numbers and with great difficulty only—while in the wet season they are out and moving about in the open and therefore easily captured. Thanks to the good offices of the Captain of the Port and Señor Moreno of San Juan, I finally chartered the schooner *Guillermito* from Sr. Tomas Bonano, its captain and owner, for a two-and-one-half-month-cruise.

The fact that local and federal Government officials were actively on the hunt for a suitable vessel left me free to a considerable extent to do collecting in the eastern part of Porto Rico—territory that I had not thoroughly explored on my visit to the island in 1921. Thanks to the help of Dr. William H. Hoffman of the School of Tropical Medicine who joined me on many of these expeditions and placed his car at my disposal, I was able to examine the entire eastern mountain complex including even a visit to the summit of El Yunque. I was able to explore many of the limestone hills of the north range between San Juan and Arecibo, all of which yielded an abundance of interesting and important land mollusks.

July 3 and 4 were spent in an exploration of the island of Vieques where deforestation, cattle grazing and other agricultural pursuits have wiped out most of its mollusk fauna, leaving only those species that are capable of existing under the conditions produced by man.

The conditioning and provisioning of the *Guillermito* being completed, we set sail for the islands to the south. Our force consisted of Dr. William H. Hoffman and his assistant Mr. J. Oliver, Capt. Bonano, mate, two sailors and a cook.

After a brief stop at Culebra Island I spent one day exploring St. Thomas Island, and on July 13 we came to anchor in Hurricane Harbor at the east end of St. John. The next day I climbed to the summit of Mt. Bordeaux where, after passing out of the lowland torrid cactus-fringe zone, I found very good collecting in the tropical forest, particularly near the summit where the Bay Rum tree (*Anomis caryophyllata*) grows, from whose leaves the aromatic oils

used in the manufacture of the famous Virgin Island bay rum are distilled.

On July 15 we explored the north end of St. Croix Island, which failed to yield much material for our efforts. Most of this island, like Vieques, is under intense cultivation which spells death for the native fauna.

Our next anchorage was Road Harbor, Tortola, which we reached after many tacks. An exploration of the stand of virgin forest on the summit of Mt. Sage yielded a splendid representation of the local molluscan fauna as well as unforgettable glimpses of West Indian scenery. At noon on July 19 we reached Long Bay, Virgin Gorda Island, a volcanic island that is as dry as a bone, covered with thorn brush, cactus, and stinging vines that form an almost impenetrable tangle; every step was a step of torture, and little to reward one for it. Most of our shells were found among the tangle at the base of *bromeliads* or *orchids* that covered the summit of rock piles in the highest reaches of the mountain.

On San Martin Island we chartered an automobile and drove to Grand Case Bay, collecting at suitable places along the way and exploring the high hill bounding the bay, and later the western end of the island. After a short stay at Rendezvous Bay on the southwest side of Anguilla we next visited San Bartholomew July 23 and daylight of July 24 found us heading for the white summits of its mountains that beckoned from the harbor and promised limestone and its associated rich mollusk fauna. But alas! the punishment of spine and thorn was not rewarded; the white peaks proved a delusion and a snare—they were due to a covering of white lichens infesting them. On St. Eustachius I climbed the extinct volcano which rises sharply behind Orangetown to almost 2,000 feet and whose extreme summit and interior is clothed with virgin forest. While collecting proved not of the best—it never is in volcanic territory—I nevertheless was able to secure a representative series of specimens before darkness stopped our efforts.

On July 25 we anchored off Basseterre, the capital of St. Christopher. On a mountain rising behind the port, I followed a babbling brook, climbing over many a cataract while a tropical jungle of giant trees and a tangle of ferns and vines overarched the stream and shut out the sky. It was the first real glimpse so far encountered of dense dark tropical vegetation, and its tropic aspect was enhanced by the presence of chattering monkeys overhead, whose curiosity was aroused by our presence. Groups of mollusks not met heretofore were present here, among them a large *Planorbis*, probably *guadalupensis*, the intermedi-

ate host of the blood fluke, *Schistosoma mansoni* that produces the dreaded malady known to the medical fraternity as bilharziosis. This mollusk simply swarmed in the little stream, hundreds of them occurring in each little pool. Since the African gray monkey which has been here mentioned has been found to share with man the honor of being a host to *Schistosoma*, it fairly made one's blood run cold to think of the chance of infecting all the people bathing in or drinking water from this source. Efforts should be made to eliminate the monkeys and thus prevent stream pollution by them. Likewise efforts should be made to exterminate the mollusks.

The climb of Mt. Misery (4,314 ft.) on July 26 from the Belleview estate was a trying one, the slender trail having been wiped out by last year's hurricane, every step in the higher reaches requiring the use of the machete. From a scenic standpoint it was wonderful, every prospect being a joy; from the molluscan viewpoint it proved quite poor; tree- and bush-dweller and a few leafmold-inhabiting species furnishing the bulk of our catch.

On July 27 we visited Nevis which proved to be one of our best collecting grounds, yielding thousands of specimens of land shells of quite a host of species; even fresh water mollusks, *Planorbis* and *Physa*, occurred abundantly in small pools.

On Montserrat I gathered quite a large number of land mollusks on the mountain side and a lot of fresh water things from a small stream at its base, and at 9:30 p. m. we left for Guadeloupe Island, stopping at Grande Terre, the island abutting Guadeloupe on its east side. This is a recently elevated limestone bank teeming with land mollusks, their abundance reminding one of the Cuban magote fauna.

A startling feature was the water supply of the southeastern part—usually funnel-like depressions, natural or scooped out of the soil which are filled by rains during the wet season and gradually become contracted as the use of the water by man and beast and evaporation diminishes their contents. These pools are stocked with aquatic plants and harbor a good assemblage of freshwater mollusks, the Apple snail, *Physa*, and *Planorbis*; of the latter several species were most abundant among which is *Planorbis guadalupensis* which occurs in such prodigious numbers in most of these pools that the dead shells form a veritable pavement on its shores.

What dangers the people wading in these ponds or drinking their polluted and unfiltered water may run can only be determined by a medical examination of the natives, the setting for Bilharzia being perfect.



FIG. 83.—*Planorbis guadeloupensis*, the intermediate host of the blood fluke *Schistosoma mansoni*, which produces the dreaded disease known as bilharziosis, from the island of St. Christopher.



FIG. 84.—A glimpse of Santa Lucia from the sea to the south of the island, showing its extremely rugged character.

July 31 was devoted to Guadeloupe; the splendid roads made it possible to easily reach Basse Terre from Pointe à Pitre, and while much of the island is under cultivation, patches remain along the roadside here and there where remnants of the fauna are still to be found. Then too, many of its mountains are so steep that agricultural pursuits are more than difficult and this lends shelter for their maintenance. The scant fauna, both as far as species and specimens are concerned, was due to the character of the soil which here is purely volcanic and forms a marked contrast with the abundance of forms on Grande Terre where lime is present. While I did not reach the summit of Soufrière, the highest peak of this wonderfully cut up island, I did climb sufficiently high to secure representative material from the mountain fastnesses.

August 1 and 2 were devoted to the Saints; St. Paul yielded a goodly catch of bush-dwellers; St. George's Island proved dry and barren; St. Peter showed quite a fauna on one spot where a bit of elevated coral reef remained half way up to the summit.

On Maria Galante Island we found a duplication of Grand Terre conditions and an equally abundant mollusk fauna. Maria Galante is evidently a bit of the same uplift which caused the emergence of Grand Terre from the sea; not only did the land yield mollusks in abundance but the streams were equally productive.

The island of Dominica proved to be another of the tortured volcanic products just then blessed with much rain. All the mountain peaks wore their cloud caps and collecting had to be done in rain gear. An auto road winds picturesquely over the mountains to the east coast and along this our collecting was done in suitable localities. The piles of rubbish under the neatly raked Cacao groves were particularly rich in mollusks.

At Rosseau we explored the Botanic Gardens, a splendid collecting ground, and made a survey of the beautiful valley behind the town as well as the elevated reefs of Morne Bruce above the Botanic Gardens and Morne Daniel at Telegraph Hill.

Sleepy winds gave us the chance to admire the north and west shore of Martinique on August 7 more than we really cared for. Viewed from the north side the eastern profile enjoys a slow gradual slope. The contributions of Mt. Pelees' last effort have as yet not been cut up and carried to sea by wind and weather. The north and west sides are chewed up as badly as Dominica. The afternoon was spent in examining the bold shores of the Bay of Fort de France and yielded little.

August 8 however, was one of the most marvellous days of the entire trip. An automobile carried us from Fort de France north-



FIG. 85.—On the summit of Mount St. Andrews, island of St. Vincent, showing the wonderful development of epiphytic vegetation, as well as a tangle of ferns. A splendid collecting ground for mollusks.



FIG. 86.—Mineral Springs, on the northeast end of the island of Granada, where we found a rich South American fresh-water fauna of mollusks.

ward toward St. Pierre up and up around many a hairpin curve, winding in and out and twisting about an endless number of turns which taxed the splendid driving capacities of our chauffeur to their limit. Our drive to St. Pierre was magnificent, every turn a picture; the mountains so steep that on a rainy day like this it is almost impossible to get a foothold. But even on these steepes agriculture is being pursued which leaves little of the native fauna. The extreme tops of the mountains are treeless, but covered with brush and grass and that awful pest the staghorn fern which ever and anon comes down to the road. The timber creeps up the gullies, and splendid tree ferns and slender palms lend an unusual charm to these mountain vistas. In sight of St. Pierre we turned eastward and in a roundabout way completed our swing back to the capital by night.

On our way to Santa Lucia August 9, we stopped off Diamond Hill, Martinique, and made a collection of shells on its timbered summit. After exploring parts of Santa Lucia and St. Vincent islands, we then set sail for the Grenadines. Between St. Vincent and Grenada there are scattered quite a number of islands and islets and rocks which are collectively called the Grenadines. These are of course of interest because they too have served as stepping stones in the northward migration of the flora and fauna. I visited and collected on the following islands: Bequia, Quatres, Petit Nevis, Mustique, Baliceaux, Little Mustique, Cannouan, Mayero, Union, Petit Martinique, Petit San Vincent, Carriacou, Salina, Frigate, Ronde, Diamond, and Caille. On each of these islands all possible efforts were made to secure a representative lot of mollusks. Our labors were crowned with varying degrees of success this being largely in inverse proportion to the amount of cultivation and deforestation to which these islands have been subjected. One very interesting and instructive feature was the finding of a half-grown *Physa* in a pool near the summit of North Hill, Carriacou, in a grass-grown depression filled by recent rains, evidently carried here by some wader. A spotted sand-piper was fishing in the same place. The study of the distribution of fresh water mollusks must take the migrating shore birds under consideration as factors for they undoubtedly play an important rôle in their distribution.

We arrived in St. George Harbor, Grenada, Sunday evening, August 25, and remained here until August 28. The splendid automobile roads everywhere and the kind helpfulness of the officials enabled us to obtain a fine collection of land shells from many stations. The most startling find however, was in a small stream at Mineral Springs in the northeast part of the island, where a little stream rich in lime



FIG. 87.—In the deep forest of Trinidad, showing a primitive sawmill in action.



FIG. 88.—Home life on Margarita Island, where the cactus and its spines serve as clothesline and clothespins.

salts supplied an abundance of *Ampullaria*, *Marisa*, *Planorbis* and *Paludestrina*; these specimens being present from the source of the little stream to where it merged with the acid water of a larger stream coming from the volcanic mountain side, a distance of about the length of two city blocks, when they completely disappeared, being unable to maintain themselves in such an unfavorable environment. This alkaline water was doubtless also stocked by migrating waders and birds carrying the eggs or young of these mollusks on their feet probably from Trinidad, the nearest place where they occur.

September 1 to September 4 we spent on Trinidad, the largest and most beautiful of all the Lesser Antilles, stopping now in the lowlands, now on the summit of its high mountains exploring pools and streams and even the puddles in the asphalt pit that is paving United States streets. Thanks to the officials of the Imperial College of Agriculture and their friends, particularly Professor F. W. Urich, every moment of our time was used to the best advantage. Trinidad is such a large island with such a diversity of habitats that a month of collecting would be hardly enough to harvest its possibilities. It is to be hoped that this will be done in the future by the students of the Imperial College of Agriculture under the wise guidance of Professor Urich. Here as elsewhere we found the forest fauna a scanty one, but where limestone was present an abundance of species and specimens was assured.

Having completed the southward swing we headed for Margarita Island off of the Venezuelan coast and spent September 7 and 8 collecting in this dry and bleak habitat, which, in spite of its unfavorable appearance, yielded a host of land mollusks and other things, the next island, Orchilla, however, yielding not a single land shell.

We therefore promptly set sail for El Roque, a collection of islands and islets west of Orchilla, and devoted part of a day to a careful search of its tall main island at the western end of the group. Here, as on Orchilla, land mollusks were conspicuous by their absence, but the place was swarming with lizards, and birds were equally abundant in its mangrove swamps; we added a goodly number of each to our collections.

To give even a half-way satisfactory description of the next islands visited, Bonaire, Curaçao, and Aruba, would require more space than is available—suffice it to say that our visit to them yielded among other land shells, a handsome lot of *Cerion*, whose presence here is one of the most fascinating problems of geographic distribution in the whole field of mollusks, their nearest relatives being in Porto Rico.



FIG. 89.—The seabeach and shore line on the north side of the island Orchilla.



FIG. 90.—Iguana hunting on the island of El Roque.



FIG. 91.—A cactus fence on the island of Bonaire. In the protection of such fences many land mollusks are to be found.



FIG. 92.—*Cerion uva* on the base of a tree on the island of Bonaire, showing the abundance of these mollusks.

The morning of September 19 saw us under way for the home port of the *Guillermite*, San Juan, Porto Rico, which we reached on September 24, completing a cruise—or may I say an inspection tour or collecting trip—which my hopes had let me long for, but which my fondest dreams had scarcely permitted me to believe possible of accomplishment within the time allotted. Great credit for this is due to Captain Bonano and his crew. The collections of mollusks obtained are sufficient to enable me to give an adequate treatment of them in the future. Their study in the field makes intelligible the problem of their distribution.

For the opportunity of making this study I am greatly indebted to the officials of the Smithsonian Institution and I am equally grateful to our Department of State for its efforts on my behalf with foreign governments, and to the representatives of those governments in the various islands for their unvarying courtesy and help.

COLLECTING FLIES IN NORTHERN EUROPE

By J. M. ALDRICH,

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Since the land masses of the Old and New Worlds come close together at Bering Strait, and did in fact once connect there; and since the climatic conditions are on the whole very similar in the northern part of both hemispheres, it is not surprising that the animals should have a marked similarity in North America and Eurasia in the northern regions. A long list could be made of cases where the same species of plant or animal occurs in both continents, as determined by examining specimens from both; but lack of material for comparison, especially in the smaller forms, leaves a great deal of uncertainty as to the identity. It was to provide such material in as many cases as possible that I undertook in the past summer to carry out the project here described. The investigation of the problem through the numerous species of flies promises more interesting results than would be obtained in other orders of insects, for the simple reason that the flies are so plentiful in the north, having their region of greatest abundance approximately between 50 and 60 degrees north latitude; while all the other large orders dwindle greatly in that cold climate and have their greatest numbers farther south. Many American species of flies have been described without the proper examination of related Old World forms, and in some cases they will no doubt be found to be identical with the latter. The problem will not be completely solved for many years, but even a small collection of a few thousand Old World specimens will afford opportunity to make a little progress in it. Hence my object was to obtain as many flies as possible in the time available.

Before beginning this work, however, I spent considerable time in the examination of the type specimens of American flies in the British Museum and in the important private collection of Mr. J. E. Collin at Newmarket, England; and after my collecting trip was finished I returned by way of Stockholm, Copenhagen, and Paris, where museums long established contain additional type material of importance.

I reached Bergen, Norway, by boat from Newcastle, England, on July 10. As I did not leave on the northward journey until evening of the following day, a little time was available for collecting flies here. Taking the funicular railway to its terminus a thousand feet above the sea on the stony mountain against which the town is built, I walked

along a country road ascending still higher among small trees. The weather was too wet at first for collecting, as flies must be kept dry; but in the course of an hour or two the mists became thinner and the sun came out. Flies were abundant, and most of those collected could be readily identified as belonging to species which are known to occur also in North America. Some require further study.

After two nights and a day of travel by boat up the Norwegian coast, the town of Trondhjem was reached. This is a city of 55,000 population, situated in latitude 63 degrees 26 minutes, or a little farther north than the northern extremity of Labrador. I arrived here



FIG. 93.—Bergen, Norway, looking north.

July 13, and remained two days, but the weather was continuously rainy and cold, so I could not collect.

I then left by rail and proceeded eastward into Sweden, continuing in the same latitude. The railroad climbs the low mountain range, entering Sweden near the divide. The first Swedish town, Storlien, was where I intended to stop, but on account of the higher altitude it was even colder and rainier than Trondhjem; so I continued eastward, changing from the national railway of Norway to that of Sweden, and stopped at Åre, a small tourist place on the river of the same name. The Åre River widens into a lake here, from which the slopes of the low mountains rise so abruptly that there is only a little land that can be cultivated, close to the lake, and even this is very steep. On account

of the cold climate, agriculture consists mainly in raising cattle and hay, and the hardier garden vegetables.

On my arrival in Åre the weather was still cold and damp. The Grand Hotel had the steam heat on, an unusual thing in Europe and most acceptable to an American. For two days there was but slight improvement in the weather, but I found under trees some spots dry enough to collect flies, and accumulated a satisfactory number. Then the weather cleared, and for the following three days the collecting was remarkably good, there being thousands of flies on foliage and flowers. Sorting and pinning the specimens took up considerable time; on the first fair morning I got so many flies in sweeping for



FIG. 94.—Åre, Sweden, looking southeast.

two minutes on flowers of dill that it took an hour to sort them and pin all worth keeping.

On my fifth and last day in Åre I ascended the mountain Åreskutan, just back of the railroad station. This mountain is of unusual interest to the entomologist because Zetterstedt, nearly one hundred years ago, collected flies here and has recorded many species from Åreskutan in his series of volumes called *Diptera Scandinaviae*. The altitude of the railroad station is about 1,500 feet, while that of the summit is about 5,000 feet. The part of the climb of most interest to the entomologist is the first thousand feet above the station, or up to about 2,500 feet. This is mostly through the spruce zone, which covers the slopes from 1,500 to 2,300 feet, stopping quite abruptly at this level and being replaced by birch, which continues about



FIG. 95.—Åre, Sweden, looking northwest. Hayracks in foreground.



FIG. 96.—Looking northwest up Åre River, Åre, Sweden.



FIG. 97.—Looking south across lake at Åre, Sweden. Spruce and birch zones on mountain side.

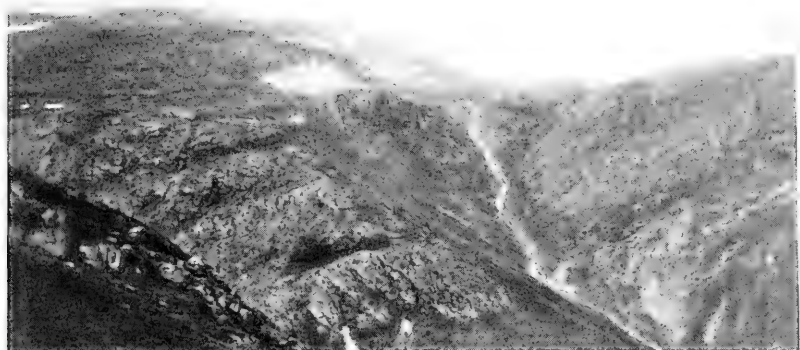


FIG. 98.—Åreskutan, Norway, July 19, 1929. Summit at left.



FIG. 99.—Above tree zone, Åreskutan, Sweden, July 19, 1929.



FIG. 100.—Oestersund, Sweden, from island in lake.

300 feet higher, beyond which there are no trees and very little vegetation of any kind. The zones of vegetable growth are substantially what we would call in North America the Canadian (spruce), the Hudsonian (birch), and the Arctic. The flies were most numerous in the first named, and there were very few in the third.

Leaving Åre on the evening of July 20, I continued my journey to Oestersund, the capital of the province of Jemtland, 75 miles east and a little south. Here I remained two days to collect, having good weather and getting a good series of flies, many different from those found in Åre. The surrounding country is level, and there are no mountains close by. The city, which has something like 15,000 population, is situated on a large lake, and is connected by a bridge with a rocky island on which a part of the town is built. My collecting was mostly on this island and on the lake shore north of the city. The gentle slopes extending back for about a mile from the lake shore are well drained and are all in cultivation, hay and barley being the main crops. There is a dense agricultural population close to the lake, but farther back on the level the country is boggy and unfit for agriculture. The farm buildings are all of wood and well painted, usually red with white trimmings. The red-tiled roofs however present a quite different appearance from the shingled ones of the United States. This is in a latitude corresponding to the northern edge of Labrador, in North America, but not quite so far north as Fairbanks, Alaska.

After two days in Oestersund, I went to Stockholm, Copenhagen, and Paris for more study of American flies in the museums, and sailed for New York from Cherbourg, on August 17.

BOTANICAL EXPLORATION IN AMAZONIAN PERU AND BRAZIL

BY ELLSWORTH P. KILLIP,

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The plant life of the eastern slopes of the Andes Mountains and the adjacent lowlands of the upper Amazon and its tributaries is very scantily represented in the U. S. National Herbarium. Most of the collecting in that area has been done by European botanists, as Spruce, Poeppig, Ule, and Tessmann, and their collections are deposited in European herbaria. In this region grow plants of great medicinal and general commercial value, which are coming more and more into the life of the people of all countries as the territory is being opened up by highways and railroads, the improvement of river navigation, and the airplane. Requests are continually being received by botanical institutions for precise information regarding these plants, but in the absence of adequate material in their study collections answers to such queries necessarily are often meagre and unsatisfactory.

With a view to obtaining a general collection of the plants of the eastern slopes of the Andes of Peru and of the eastern and north-eastern parts of that country known as the *montaña*, an expedition was sent into the field by the Smithsonian Institution in March, 1929. The party, consisting of Mr. Albert C. Smith, Mr. William J. Dennis, and myself, reached Lima April 9, arrangements then being made for proceeding to the *montaña* with the least possible delay in the high mountains. Fairly large collections, however, were made at three points in the cordilleras: Río Blanco, at 11,500 feet altitude, on the remarkable railroad which, starting at sea-level, crosses the Andes at 15,600 feet elevation, and follows the Mantaro Valley to the important city of Huancayo; Tarma, on the main route of travel between Lima and the *montaña*; and at the base of the glaciers on Mount Juntay, 15,000 feet above sea-level. On our visit to this interesting isolated snow-mountain we were accompanied by Mr. Paul Ledig, director of the Magnetic Observatory of the Carnegie Institution, our headquarters at Huancayo.

At Huanta, a town several miles south of Huancayo, in the Department of Ayacucho, we outfitted for our first trip to the *montaña*. To hire mules was impossible, so the subprefect of the province sent soldiers into the surrounding country to commandeer beasts and equip-



FIG. 101.—Market day at Huancayo. In existence at the time of the Spanish Conquest, this market still attracts Indians from a wide area every Sunday. The gay dress of the people and the bright handmade blankets on sale give color to the scene.



FIG. 102.—Mount Juntay, near Huancayo. The peaks of this snow-covered mountain, over 17,000 feet above sea-level, can be seen from many points in the Mantaro Valley. The hardy llama, with its dense coat of wool, alone of beasts-of-burden can exist at these highest altitudes.

ment. And a weird assortment of animals they brought back! The irate owners were not mollified until permitted to select a representative to accompany us.

The scenery along this trail to the Apurimac is superb. Two distinct ridges are crossed at about 14,000 feet altitude before the trail makes its final descent to the jungles. For the first part of the trip the mountain sides are a riot of color—blue lupines, yellow calceolarias, orange alonsoas, and mutisias, pink orchids, and red salvias everywhere. At these higher elevations there are a few shrubs and an occasional low, much-gnarled tree. But, on the third day out, on passing through a



FIG. 103.—Primitive life at Pargora, in the high mountains between Huanta and the Apurimac River. The cold here is intense, and the natives are usually shivering as they do the little work necessary to eke out a miserable existence.

gap in the mountains, we saw the Amazonian forest spread out below, a dark sea of treetops, relieved only by the pale leaves of *Cecropia* and the brilliant yellow flowers of *Gaiodendron*, a tree related to the mistletoe. The real forest begins at Aina, a small settlement at which headquarters were established for a few days. The trail to this point is fairly good, but from Aina to Kimpitiriki it is merely a succession of decaying logs, half-fallen bridges, and deep mudholes. Animal life was scarce, though the numerous wounds on the backs of the mules each morning showed that vampire bats were abundant in this region.

Kimpitiriki, a Franciscan mission, was the farthest point reached by the expedition in this part of the country, and from here we retraced our route to Huanta, Huancayo, and Tarma. From Tarma we pro-

ceeded to the montaña region known as the "Chanchamayo," from the river of that name. Strangely, this 48-mile auto ride from Tarma to La Merced provided one of the greatest thrills of the trip. The total descent is about 7,700 feet, the greater part of this coming within a very few miles, where the highway descends in a series of **S**-curves from the top to the bottom of the Tarma valley. The road is scarcely wider than the car and one-way traffic is maintained, passage going up and down on alternate days. With their inherent love of excitement the native drivers make little use of brakes, the car swerving around curves with the out wheels almost in the air, brushing against jutting cliffs, and shooting through tunnels. To meet a cow, strayed from her hillside pasture to the road, or a mule caravan proceeding in the wrong direction is embarrassing, to say the least. Obviously it was impossible to collect many plants en route, but later we returned to two especially inviting localities, Carpapata, where we were the guests of Mr. A. D. Bryant, of the Cerro de Pasco Copper Corporation, and Huacapistana, a locality made famous botanically by the collections of Dr. Weberbauer, the distinguished botanist of Lima.

In the Chanchamayo, collections were made from three principal bases: La Merced, the hacienda of Señor Carlos Schunke above San Ramón, and the Perené Colony, where we were entertained for two weeks by Señor Victor Valleriestra. For much of the success of the trip we are indebted to such hospitable Peruvians as Señor García, Señor Valleriestra of Tarma, and to the government officials at Lima, and to the prefects and subprefects of the departments and provinces visited.

The Perené Colony is at the end of the auto road, and from here into the montaña travel is solely by mule trail, river, and air. Mr. Smith and I started over the famous Pichis trail June 28, our caravan including eight cargo mules. The trail reaches a height of some 6,000 feet, and for the entire distance there is a succession of changing types of vegetation. At intervals of 20 to 35 kilometers, a day's travel, very satisfactory *tambos* (as the small inns are called) are located, and whenever we came to one of these in a region of special botanical interest we would delay a day and make as large collections as possible. Of unusual interest was an open sphagnum bog, much resembling those of northern regions, where terrestrial orchids were abundant and where we found a familiar plant, our common cinnamon fern. At one of these *tambos*, a flimsy-looking house made of palm trunks and thatched palm leaves, we had our only serious misadventure of the entire trip. Our presses slung over kerosene burners caught fire, and



FIG. 105.—Indians of the Campo tribe, living along the banks of the Perené River. Their huts are very simple, merely a few poles supporting a roof of palm leaves. The plant carried by the Indian is a species of *Cracca*, the roots of which are used as a fish poison.



FIG. 104.—Deraïlment of a train along the Huancayo-Mejorada railroad. There is a sheer drop of 1,000 feet to the Mantaro River, on the right.



FIG. 106.—Canoeing on the Perené River. Much skill is required to manage these boats in the swift waters of the smaller mountain streams of the Amazon basin.



FIG. 107.—Making a canoe from a mahogany log. The trunk is cut longitudinally; the shape of the proposed boat is outlined with strips of palm stalks; the surplus wood is removed by fires built about the log and by machetes, the native knives. Scene near Yurimaguas.



FIG. 108.—A fishing party near Yurimaguas. Roots of a poisonous plant locally known as "barbasco" are mashed in water in the bottom of a canoe. The water is thrown into a small stream, resulting in the stupefying of large numbers of fish. These are then readily caught with net or spear.



FIG. 109.—The final process of making herbarium specimens. When the plants are brought in, portions are laid between sheets of blotting paper and corrugated cardboard, cinched together, and slung over oil burners. The heat passing through the cardboards dries the specimens in a short time.

soon the entire room was in flames. Quick and judicious use of water saved the building, and fortunately only a few specimens were scorched.

The Pichis trail ends at Puerto Yessup, on the Pichis River, and from here we went by canoes to Cahuapanas, stopping four days en route at Puerto Bermudez. In many ways this was the most interesting part of the entire trip. The river is sufficiently narrow to permit a good view of the plant and animal life on its banks. Noisy monkeys swung from tree to tree; alligators and giant turtles basked on the muddy shores; flocks of brilliant birds of the parrot type flew over the tree tops. The river itself was a swift-flowing stream, with numerous rapids and whirlpools. At shallow stretches we would disembark and drag the canoe to deeper water. Once the current swept us close to the shore, and an overhanging branch pulled one of our trunks and the steersman into the water, but both were speedily rescued. At intervals our Indian paddlers threw dynamite into the deep pools, then dove for the stunned fish; these fish, an occasional bird, and turtle-eggs supplemented the canned provisions taken on the trip.

From Cahuapanas, a mission on the lower Pichis River, we traveled by motor canoe and steam launch to Masisea, on the Ucayali River, just below the mouth of the Pachitea. We reached Masisea July 25, 27 days after leaving the Chanchamayo. Mr. Dennis arrived by airplane the same day, having made the trip in two and a half hours, a good illustration of the difference aviation is making in travel time in the backwoods of South America, even making allowance for our collecting on the way.

Iquitos, which was to be our main headquarters for the remainder of the trip, is five days by steamer from Masisea, and is situated on the Amazon, a short distance below the point where that river is formed by the junction of the Ucayali and the Marañon. It is a thoroughly progressive city of about 12,000 population, one of the most charming cities I have visited in South America. It is a surprisingly healthful place, almost entirely without malaria and other tropical diseases that prospective travelers fear. It would serve as an ideal base for biological exploration of the upper Amazon country, the great Peruvian rivers, the Ucayali and the Huallaga, and the Ecuadorean rivers, the Napo, Tigre, Pastaza, and Santiago, all entering the Amazon (or the Marañon as the upper Amazon is called) within easy reach of Iquitos.

A four-day trip to Yurimaguas, at the head of steamer navigation on the Huallaga River, brought us into a different section of the Amazonian jungle, its flora quite distinct from that of the Iquitos area.

Mr. Smith went on foot to Balsapuerto, 50 miles west of Yurimaguas, at the base of the Andes, bringing back a valuable collection.

I spent several days along the right-of-way being cleared for the proposed railroad from Yurimaguas to the Pacific. One of the most difficult problems for the botanical collector in the tropical jungle is the making of herbarium specimens of tall trees and high climbing lianas. To cut down a giant tree not only requires much time but very often the upper portion merely falls upon some other tree, which in turn has to be chopped down, or is supported high up in the air by a net work of woody vines. So a place where the land is being cleared is sought. Along this right-of-way it was a comparatively simple



FIG. 110.—Fishing craft at Pará. Every evening these boats return to port, well laden with the fish of the lower Amazon.

matter to obtain specimens not only of the large trees themselves but of the dense epiphytic growth covering the topmost branches.

While Mr. Smith and I were in the Yurimaguas section Mr. Dennis went to the rapids of Manseriche, at the head of navigation on the Marañon, exploring also the lower portions of the Morona and Pastaza rivers. So far as known, the only botanical collecting previously done in this region is that of Tessmann, a German botanist stationed for several years at Iquitos.

Plans for the field-work of the expedition called for our spending all our time in Peru, so the 2,000-mile trip from Iquitos down the Amazon to Pará was made as speedily as possible. It was, however, rather an aggravation to cross Brazil at almost its widest part with-

out making large collections. While waiting for steamer connections at Manáos, time was found for a few short collecting trips, one made in company with Dr. Adolfo Ducke, of the Jardim Botânico of Rio de Janeiro, being of particular interest. Fairly ample collections were obtained also at Gurupá, on the lower Amazon, and on Mosqueiro Island, in the mouth of the Pará River.

Two complete sets of specimens were made for the National Museum and the New York Botanical Garden. A nearly complete third set will be deposited at the Field Museum of Natural History, where special study is being made of the flora of Peru. A large number of extra duplicates were gathered also for distribution to other institutions at which particular groups are being studied.

The collection numbers total 9,166, so that approximately 30,000 specimens are being brought out of Peru and Brazil by this expedition. It is hoped that the material will prove of such definite scientific interest and practical value that further botanical exploration of the upper Amazon region will be regarded as important. As previously mentioned, Iquitos would be an excellent headquarters from which to work. Even at present there is much interest in biological investigations in the city, due largely to the activity of Doctor H. M. Bassler, geologist of the Standard Oil Company of Peru, who encourages his employees stationed in far outposts in the forest to collect specimens of bird, mammal, and plant life. Indeed, to Doctor Bassler and Mr. G. M. Ker we are greatly indebted for valuable assistance, which went far toward making our work in this region successful.

BOTANICAL EXPLORATION OF NORTHWESTERN HAITI

By E. C. LEONARD,

Assistant Curator, Division of Plants, U. S. National Museum

The northwestern peninsula of Haiti with its numerous and diverse plant associations has long been in need of thorough botanical exploration. I was fortunate in being assigned to this work, fostered by Dr. W. L. Abbott and the Smithsonian Institution.

In pitch darkness, on the night of December 20, 1928, my wife and I were unceremoniously "dumped" from the Columbian freight steamer *Martinique* into a small rowboat and pulled ashore at Port de Paix amid the excited chattering and ogling of the usual crowd of wharf loiterers. After placing our cumbersome baggage in the Customs House we were taken by auto, without a word of explanation, to the boarding house of Madame Chee Chee (short for Theodore), which was to be our occasional home throughout the ensuing months. This apparently unsolicited attention remained a mystery to us until two days later, when we learned that it had been by order of Captain Peter Hartmann of the Gendarmes, who proved thenceforward our counselor and friend-in-need.

Port de Paix, second in size to Cap Haitien on the north coast, lies between two of a series of mountain spurs extending seaward from Morne Haut Piton, a mountain whose size and height can be judged only when viewed from a distance. The region roundabout is moist and very productive, and is thickly populated, the town itself a center of the coffee and cacao industry. The following five days, interrupted by periods of sickness, were given to the assembling of equipment and to collecting from the nearby hills. Finally we were able to cross, in a small fishing boat, to Tortue Island.

La Vallée, on Tortue Island, is a short, deep, many-branched valley which nearly severs the backbone of the island and is easily seen from the mainland. Here we made a landing on the crumbling cement wharf used in the past by a lumbering company, as scattered fragments of machinery and an old narrow-gauge engine, all but swallowed by the jungle, plainly indicated. We set up our tent, or *caille avec planches*, as the natives called it, under a large bayahon tree, where, embarrassed by constant visitors, bitten by fleas, worried by hogs and dogs, we managed to live two weeks, busily collecting and



FIG. 111.—Low “scrub” vegetation of the coastal plateaus near Cabaret, a century plant (*Agave*) near the middle.



FIG. 112.—Native “prickly pear” trees (*Opuntia*) along the shore at La Baie Moustique. Our guide, Saül, at right.

drying plant material. Here also we became acquainted with Saül, who adopted us on sight and became our friend, guide, "man Friday," and social equal, all in one. We were interested to learn that he had previously conducted Dr. Abbott and Dr. Ekman on their visits to Tortue. Although his total knowledge of English was "Seet down," "You want watah?", his patience and good nature rendered him invaluable as a teacher of his native creole lingo.

Usually on Wednesdays and Saturdays the entire neighborhood gathered on the beach of La Vallée, either to go to market at Port de Paix or to send their produce—plantains, potatoes, pumpkins, pigs,



FIG. 113.—An abandoned locomotive, half hidden by the rank jungle of La Vallée, Tortue Island.

fish, and goats. The boats were invariably loaded to the gunwale and the start was an occasion of great excitement and rivalry as to which would be the first to get off. One morning, unfortunately stormy, we set sail in the largest boat available and finally reached Port de Paix, drenched to the skin.

We had returned to Port de Paix for recuperation, but being at once made ill again were glad to get off, after a few days, to Caberet on La Baie Moustique and boil our usual stews over the open fire. Caberet must have been a considerable settlement in the old log-wood days, but we found it nearly deserted, its houses falling into ruin. A small dirty stream, all that is left of the Moustique River after its

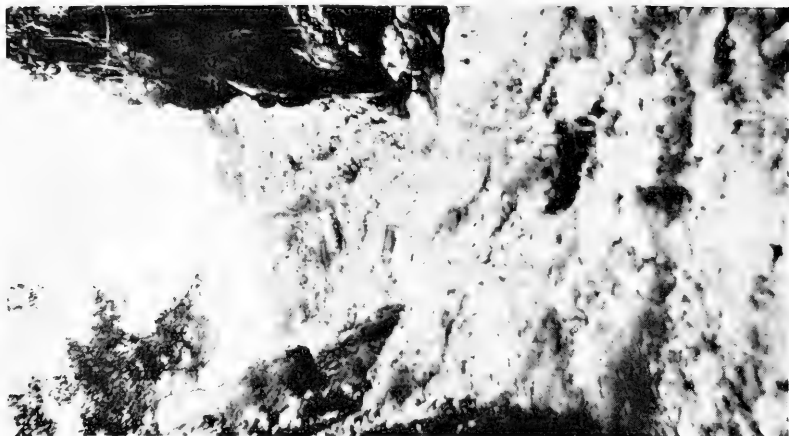


FIG. 116.—Rough coral formation at the mouth of Rivière Côte de Fer.



FIG. 115.—A tree trunk bearing clambering cactus plants in flower, with tufted "wild pines" above.



FIG. 114.—Frequently we had willing assistance in gathering up our plant drying papers.

long run through the arid coastal region, furnished baths to goats, donkeys, and pigs, and to us drinking water. After a fortnight of successful work we returned to Port de Paix.

Our next collecting was done at Jean Rabel, which we reached by a night launch ride in a calm sea with Captain Hartmann. Here again we set up tents, this time on the bank of the Jean Rabel river, a swift-flowing stream of clear water. Jean Rabel is a sizeable village, boasting a drug store, gendarmerie, and a large market, but is surprisingly situated several miles from the coast. Under these favorable circumstances we were able to devote all our time to collecting. The level plateaus bordering the barren sea cliffs, covered with shrubs barely a foot high, were especially interesting and easy to collect. To the south lay low mountains, which though found to be equally productive were difficult in the extreme to penetrate, owing to lack of roads other than winding goat trails lined with "jumping" cactus and thorny bushes.

Several weeks were spent at Jean Rabel. After shifting so long for ourselves we had, one day, the pleasure of welcoming Lieutenant Whitehouse, sent to take charge of the local gendarmerie. From him we gained an insight into the mysterious and complicated system of local politics prevailing in all Haitian towns, and with his help we procured much-needed pack animals with which to make the trip to the Mole, Bombardopolis, and back.

The trail to the Mole follows along an old sea shelf, winding mile after mile through arid thickets and huge cactus groves, with not even a Haitian hut and only one stream, La Rivière Côte de Fer, to break the monotony. Most of the trip was made afoot and with more or less difficulty. Toward night camp was set up under a huge mango tree, in the deep gorge of the Mole River. From this point Saül and I scouted the rocky arid wastes of the surrounding regions for seven or eight days, collecting new or interesting plants which Mrs. Leonard, in addition to her numerous other duties, dried as usual.

One evening found us again on the trail, this time bound for Bombardopolis, situated to the south in the midst of a great plateau. Arriving there the following midnight, we hastily made camp and crawled in under double blankets to escape the cold. Next morning we were awakened by a large body of excited citizens headed by their police, all astonished that a family of "blancs" with tents and complete living equipment should appear so suddenly out of the blackness of night. A detailed report of ourselves satisfied the police, but nothing seemed to satiate the curiosity of the natives who, day after day, would stare, five and six deep, in front of our tent, as long as light

lasted. Here Mrs. Leonard became a dentist, treating one cavernous mouth after another with a tiny drop of clove oil to allay the raging pains of toothache with which many of the good-natured blacks were afflicted. In grateful return they brought gifts of garden produce and, from a single large spring several miles to the west of town, drinking water. This spring, situated in the midst of an otherwise arid region, supported a curious vegetation.

Our strenuous thirty-one-mile trek back to Jean Rabel, over dark mountain trails, with four heavily loaded donkeys and a treacherous mule, though tedious, was accomplished in good spirits. It would take little effort, we thought, to go from there back to Port de Paix and to safety for our collection of 6,000 specimens. The trip from Port de Paix to Jean Rabel had required but four and one-half hours, but it actually took us eighteen days to return. A twenty-foot launch had been engaged, but owing to stormy weather it was several days before it could put in to take us off. During a lull it came and we set out, but only to be held up opposite dangerous cliffs, a few miles down the coast, by a stalled motor. A tiny sail and occasional sculling eventually brought us back to Jean Rabel late that evening, but not without moments of extreme danger. Saül was then sent on foot to Port de Paix with a message to the Captain. After several days' work, Lieutenant Whitehouse managed to get the motor started and again we set out, this time in a high sea. Blanc, our pilot, warned us, "Wind he no good. She blow like hell!", and so it did. Many prayers induced the motor to sputter along until we actually passed Baie L'Ecu, the only place a boat could possibly find shelter along that twenty miles of cliffs, when, after a sickly cough or two, the motor breathed its last, leaving us close to treacherous rocks. With Mrs. Leonard at the rudder Blanc and I were able to swing the boat around and, with one oar set up for a sail, to row back to the bay. Here a Haitian family, the sole survivors of a once prosperous village, made us at home. Not only ourselves but our equipment and collections were drenched.

Our pilot was the next to be sent for help, the engine now being totally beyond repair. Four days we waited, with only three cans of beans and a few sweet potatoes left for supplies, re-drying our specimens and searching the nearby cliffs for additional plant material, until Blanc appeared with a bunch of huskies, well fortified with rum, to row us home. This they did, taking the sea at its calmest, shortly after moonrise. They rowed to the tune of their entire repertory of creole songs, very melodious if some of them were lewd.

Just as scarce as was fresh water in our western camps, so was it plentiful in our eastern ones; in fact, the difficulty now was to keep dry. The slopes above St. Louis du Nord, wherever the soil was sufficiently rich, were crowded with coffee plantations, and the trails bordered with cacao trees. The uppermost ridges, many of them covered with a stiff red clay, supported only sweet potatoes or beans. On the rocky peaks, where even a Haitian was unable to tack a garden, flourished dense groves of thick-limbed jambos trees, literally upholstered in deep layers of moss and ornamental delicate ferns, continually drenched in sweeping billows of fog. I took Saül up, much to his terror, into this smoke, as he called it, where the mys-



FIG. 117.—A newly opened automobile road near Bassin Bleu.

terious moaning of the dimly seen jambos limbs, rubbing upon each other, brought him to the point of flight. He *knew* the sound of zombies.

A productive visit was next made by motor truck to Bassin Bleu over a newly opened road leading to Gros Morne. We tore along at breakneck speed, down steep mountain slopes, round dangerous curves, over open stream beds, until stopped by a partial dissolution of the accelerator. After the driver had tied the parts together with a string, on we dashed.

From our camp at Bassin Bleu, I managed to explore the distant Moustique Range, and, after three attempts, to scale the summit of Morne Haut Piton. Our camp life here was peaceful, though more strenuous than any. The natives had seen a "Madame Blanche" be-

fore, so we received little though courteous attention. The only serious disturbers of the peace were the scorpions.

A farewell visit to La Vallée, a few days' wholesale packing, and the ever-recurring hotel sickness—finally we were on our way to Port au Prince, to be on time for our much delayed reservations for New York.

We called, in Port au Prince, on Dr. Freeman and Dr. Barker of the Service Technique, and found Dr. Barker busily experimenting with a new palm nut procured from the vicinity of Cap Haitien. He had succeeded in extracting two oils; that from the kernel, white



FIG. 118.—Arid hills in the vicinity of Bassin Bleu. The distant mountain is Morne Haut Piton.

and semi-digestible, the other, from the fleshy orange covering, wholly indigestible. "Have you found these nuts in your travels?" he asked us. "The natives extract both oils for cooking." No; we had not seen the nuts, but the sight of the orange oil—the predominant sauce in all of Madame Chee Chee's dishes—was only too familiar!

We reached New York May 31, with 16 cases and trunks. In addition to our equipment, these contained insect collections, a quantity of shells, 160 wood samples, and approximately 15,000 plant specimens, the last a valuable addition to the growing Haitian collections in the U. S. National Herbarium.

THE ANCIENT AND MODERN INHABITANTS OF THE YUKON

BY ALEŠ HRDLIČKA,

Curator, Division of Physical Anthropology, U. S. National Museum

A full season of anthropological work along the Yukon River, from practically its inception to its two northern mouths, was made possible in 1929 through grants by the Smithsonian Institution and the Bureau of American Ethnology, supplemented by a grant from the Joseph Henry Fund of the National Academy of Sciences and a contribution from the Phillips Academy, Andover, Mass. The work along the upper third of the river, from White Horse to Fort Yukon, was restricted to mere observations; but from Fort Yukon downward intensive research was carried out both on the living Indians and Eskimo, and on the old sites and burials. The work was a material extension of that of 1926,¹ and resulted in the detailed examination and measurements of approximately 200 full-blood natives—in some places comprising all that remain; in the making of over 400 photographs and 15 facial casts; and in the collecting of 60 boxes of anthropological and archeological specimens. As in 1926 so during the present journey much kind and generous assistance and hospitality was received from the people along the river, both whites and natives. To mention them individually would be impossible; they can only be thanked collectively.² Thanks, also, are due to Dr. George

¹ Smithsonian Misc. Coll., Vol. 78, No. 7, pp. 137-158, 1927.

² Especially grateful acknowledgment is, however, due to Bishop P. T. Rowe, Head of the Episcopalian Missions in Alaska; to Dr. and Mrs. Grafton Burke, in charge of the Hospital and Mission at Fort Yukon; to Deaconess H. M. Beddle, in charge of the Mission at Tanana; to Dr. and Mrs. J. W. Chapman, in charge of the Mission at Anvik; to Father Superior P. I. Delon and to Fathers Cunningham, Lachessi and others at the Holy Cross Mission; to Mr. Volney Richmond, President of the Northern Commercial Co. and his agents; to Chris Betsch at Russian Mission, a staunch old friend of the Institution, and to Messrs. Keir and Bishop, in charge of his stores; to Harry Lawrence at Anvik and Jim Walker at Ghost Creek; to Deputy Marshal Johnson, at Marshall; to Mr. and Mrs. Fred Watson, the traders, and Mr. and Mrs. McClung, the teachers, at Pilot Station; to the authorities of the Alaska Railroad and the Captains and other officers of their steamers; and last but by no means least to Mr. and Mrs. Calvin F. Townsend, our hosts for two weeks on the *Coot*, the fine new boat of the U. S. Bureau of Fisheries on the Yukon. Thanks are further hereby extended to the U. S. Geological Survey for the loan of a launch, which proved of great value to the expedition; and to the U. S. Bureau of Education, for its kind cooperation.



FIG. 119.—At the source of the Yukon.



FIG. 120.—Dr. Hrdlička standing beside the canoe in which over 1,500 miles was covered along the Yukon and its side channels.

Malý, Docent in Anthropology at the Charles University of Prague, who accompanied me on the whole journey and assisted me in photography and in every other way.

The main work began at Fort Yukon on June 8, and nine days were spent here in examination and casting of the Indians. On the sixteenth, we started on the trip down the river in a light open 18-foot Peterborough canoe with an "Elto" outboard motor, visiting every village, camp, and site that could be located, down to Pilot Station, where we arrived on August 2. The journey was facilitated by the almost continuous daylight but was often made disagreeable by rainy, stormy weather. Over 1,500 miles was covered in the canoe, besides which an important side trip was made in a larger boat through the Shageluk Slough and the lower Innoko, as well as a series of trips in the mouths of the river on the *Coot* or its launch—all this, it is gratifying to report, without accident or illness, and though the work was sometimes of a rather delicate nature, without incurring the ill will of any person. The latter was perhaps due to the fact that the objects of the study and collecting were frankly explained in every case to whites and natives alike through lectures or individually, and that all recent burials were strictly respected. In many cases of the older remains I was not only told of them and conducted to the spot, which in some cases I could not have located alone, but was even assisted in their removal. There could be but little secrecy, and so the work was carried on considerably but quite openly. They soon knew me all along the river as the "skull doctor," laughed over it with much good nature, and were as friendly as possible, especially among the Eskimo on the lower river. In return they were given such medical and other assistance as was feasible and were paid suitably for every archeological specimen they brought, of which there was collectively quite a number. In but one case were we near trouble. At Ingrehak, below Russian Mission, a local full-blood brought me to a rotten above-ground grave with a clean skeleton of an old male. This was in full view of the nearby part of the village and some natives were looking on amusedly. But just as the parts were all gathered I saw below (the grave was on a slope) an old woman who appeared to be provoked at something and was talking to herself rather loudly. On sending the Indian who accompanied me down to see what the trouble was I learned that the old woman claimed the bones to be those of her long departed husband, and was saying: "Why don't they go further back of the hill where they find real old bones and leave this old man (said to have died about 30 years ago) alone." This was very promptly done, to the complete satisfaction of the old dame



FIG. 121.—The Koyukuk cemetery, at the mouth of the Koyukuk River.



FIG. 122.—Native camp, lower Yukon.



FIG. 123.—The oldest graves thus far found, lower Yukon.



FIG. 124.—Painted burial box, Innoko River.

(who later at Marshall became quite friendly) and with happy results, for there was found in the background an old site which otherwise would have escaped us.

The examination of the living, after due explanations, met with practically no objection and many thanked me for being told of their physical condition. The casting—"making stone faces" the Indians called it—was a little more difficult, but a modest compensation with the prospect of "having their faces in Washington" prevailed in most cases. The main difficulty was, not to get the consent of the people, but to find normal full-bloods—they are getting very scarce along the river, especially in its middle regions.

The outstanding scientific results of the journey can be determined clearly only after a detailed study of the data and specimens obtained. It is certain, however, that for the first time it will be possible to show definitely the anthropological nature of the Yukon population. The indications as to conditions on the river are as follows:

Ancient sites and remains, in the true sense of the word, have not yet been discovered and there appears to be no chance of their discovery unless it be through some rare fortunate accident. The reasons are that what may have existed some thousands or even hundreds of years ago has either been completely washed out by the ever cutting waters or that it lies deeply buried somewhere in the jungles of the old flats or foot hills far away from the present channels. Everything that has so far been recovered is relatively recent. It goes back only to the time of the Russians and perhaps the century or two preceding. Even the oldest known specimens belong only to the upper neolithic.

The Indians of the Yukon, so far as the evidence extends, were true Indians, with occasionally strongly marked late Asiatic affinities. They show but little heterogeneity, belonging in the main to one type, related on one hand strongly to the Thlinkit and on the other to the Athabaskan. A somewhat aberrant small group may have existed about the mouth of the Koyukuk. The Indians of the Kaltag region have been admixed and perhaps in part replaced by Eskimo, who doubtless came overland from the Norton Sound region. The Indians of Anvik have been admixed similarly and from the same direction. Between both Kaltag and Anvik and the Norton Sound there exist relatively short portages and old roads.

There is no clear line of demarcation, either culturally or physically, between the Eskimo people of the lower and the Indian people of the middle Yukon. The lower river culture was richer than that further up. It extended at least as far as Bonasila (20 miles approximately below Anvik), and possibly as far as the Greyling River (22 miles



FIG. 125.—Indian of middle Yukon, photographed at Tanana.

FIG. 126.—Eskimo, lower Yukon.



FIG. 127.—A young Indian woman from the Koyukuk.



FIG. 128.—The short and the long face among the Yukon Eskimos.

above Anvik) or even Kaltag. It was marked by a relative profusion of stone implements, the presence of the stone adze, absence of the bilateral stone axe, and more or less numerous artifacts of ivory, bone, and antlers. The culture of the middle Yukon was less rich in forms but was characterized by the bilateral stone axe and tomahawk. Pottery was of much the same poor quality along the whole river, though there may have been differences in form and decoration. On the other hand painted burial boxes, which, it would seem, are truly Indian,



FIG. 129.—The Yukon Eskimo (lower Yukon).

extended as far down as the vicinity of Holy Cross, and the language was certainly Indian (Tinneh) down to Anvik, if not to above Paimute.

Physically, too, there is no line of clear separation. Eskimoid physiognomies are encountered with decreasing frequency as far up as Tanana, Indian to the mouth of the river; while stature and skulls show no great differences. The true (not lately immigrated) Eskimo of the Yukon impresses one more like an Eskimo in the forming than like the completed product of the far north. The results of the study of the important skeletal collections from both the middle and the lower parts of the Yukon will be awaited with much interest. The population of the Shageluk Slough and Innoko River is wholly Indian,

and on the whole less admixed as yet than that of the middle Yukon. Good skeletal collections were secured here also.

The site at Bonasila yielded many further specimens, and if the erosion continues as at the present, it will continue to yield more for many years. From the collections made up to the present time and from excavations carried on this year it is now certain that the site comprised but one settlement, which began in pre-Russian times and continued to the time of the Russians. The culture, it is now seen, is essentially the same as that further down the river and must hence be ascribed to the Eskimoid rather than Indian people. The earlier skeletal remains from the site, unfortunately still too few in number, are exceedingly interesting. The site should be watched.

An important old site, hitherto unknown, has been located on the almost unknown Kaiuh Slough, lower middle Yukon. The "dogfish village" site at Tuckers, and the old parts of Holokochakat on the Shageluk Slough, are also assuming much interest. These sites would all repay careful archeological exploration.

For physical anthropology the next important and necessary task will be the study of the full-blood remnants of the people of the Kuskokwim, and the collecting on that river of such of the older archeological and skeletal remains as may yet be saved from destruction or dispersion.

PREHISTORIC ESKIMO CULTURE OF ALASKA

BY HENRY B. COLLINS, JR.

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For many years it has been the consensus of anthropological opinion that Bering Strait was the gateway through which man first entered America. It is rather surprising, therefore, that a region of such theoretical importance should not have been actually investigated until so late as 1926. While the archeological investigations of the past four years have revealed no certain evidences of the original migrants into America, they have produced results of an unexpected nature that appear to have a fundamental bearing on the question of the origin and spread of the Eskimo.

In June, 1929, I returned to Alaska for a third season of field-work in which I was assisted by Mr. G. Herman Brandt. Excavations were carried on at St. Lawrence Island, Cape Denbeigh, Imaruk Basin, and Point Hope, and additional sites were examined in a reconnaissance of the coast from Norton Sound to Point Hope in the Arctic. The greater part of the journey was made on the Coast Guard Cutter *Northland*, and the results obtained are due in large part to the interest and willing cooperation of Captain E. D. Jones.

In order to obtain information on the physical type and material culture of the early Norton Sound Eskimo, a week was spent examining old sites and collecting skeletal remains from this region. No villages were found that in size or antiquity might be compared with those on St. Lawrence Island or at other places around Bering Strait.

On June 18 we were put ashore at Cape Kialegak on the southeast end of St. Lawrence Island, where we camped for a month and excavated at the old abandoned village. The Cape Kialegak village, which I located in 1928, is 130 miles from the nearest Eskimo settlement and is one of the largest ancient sites in Alaska.

As at most St. Lawrence sites the original houses here had been built just above the beach. As refuse accumulated about them they were abandoned and became filled in and later houses were built at a higher level. The last houses, which were abandoned in 1879, were 18 feet above the beach line, sunk into the top of the huge midden that had accumulated during the centuries of occupancy.

All of these kitchen middens are permanently frozen; newly exposed surfaces thaw at the rate of from two to four inches a day so

that the task of excavating to the bottom of such a site is a slow and laborious one. In this particular case, however, we were fortunately able to proceed more rapidly. On its outer side, facing the sea, the midden rose abruptly from the beach and our method of pro-



FIG. 130.—Beginning excavation along the outer vertical face of the large midden at Cape Kialegak, St. Lawrence Island.

cedure was to strip away the outer thawed material from top to bottom and level off irregularities until a practically vertical face was exposed. When this had thawed for a few days we began at the top, and standing on a ladder took the section down with a trowel in layers two feet thick and five feet wide. This process was repeated as rapidly as the newly exposed face thawed out. The same method of excavation

was followed at a smaller site a few hundred yards down the beach. This village had been abandoned for at least 200 years and it may have been established somewhat earlier than the other, although this is not certain.

Both middens were rich in material. Large numbers of bird and mammal bones and several thousand artifacts lost or discarded by the Eskimos, all identified as to location and depth, were collected. Included were over 70 decorated specimens of ivory, most of which belonged to the style of prehistoric Eskimo art that I had found the



FIG. 131.—Camp at Cape Kialegak, St. Lawrence Island. Cleaning and drying bones from the old village.

year before to be characteristic of Punuk Island and the greater part of St. Lawrence.¹ However, there were also found nine specimens which bore the incised curvilinear ornamentation that had been previously recognized as having preceded the Punuk type.² This older style of art, which was discovered in 1926 by Dr. Aleš Hrdlička and Mr. Diamond Jenness, is marked by a profuse but extremely graceful arrangement of flowing lines, circles, and ellipses, the latter having been made free hand in contrast to those of the Punuk period which were made with a compass or drill of metal. There is no evidence that

¹ Explorations and Field-Work of the Smithsonian Institution in 1928. Smithsonian Institution, 1929.

² Prehistoric art of the Alaskan Eskimo. Smithsonian Misc. Coll., Vol. 81, No. 14, 1929.



FIG. 132.—Old Eskimo burial, Point Hope on the Arctic coast.

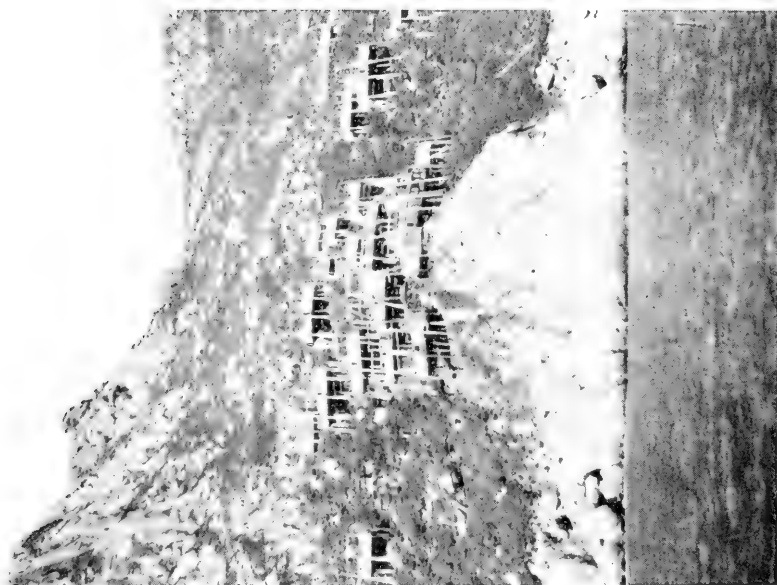


FIG. 133.—Eskimo houses built on the side of a cliff, King Island, south of Bering Strait.

metal was employed during the earlier period. While the nine older specimens referred to were all excavated from the lower levels of the middens, some examples of the later Punuk art were found at an equal or even greater depth, indicating that as a whole the Kialegak sites belonged to the later period. The nine older specimens no doubt should be explained as objects that remained in the possession of the Eskimos for some time after the art style they represented had been supplanted by another.

On July 14 the *Northland* called for us at Cape Kialegak and after a few days at Nome we proceeded northward toward Point Hope. Along the way limited collections were made and a number of Eskimos from King Island, Shishmareff, and Kotzebue were measured.

In past years several fine examples of the ancient Bering Sea art from Point Hope had found their way into various museums, and since it was very desirable to have material from an Arctic site for comparison with that from St. Lawrence, Point Hope was selected for investigation. This village, which occupies the end of a long narrow sandspit, has for centuries been an important Eskimo center. It has, however, suffered to an unusual degree from the destructive action of the sea. The north side of the spit, on which the old village is located, is being gradually washed away, while on the opposite or south side great ridges of sand and gravel are being deposited. Ruins of old houses are still to be seen in considerable number but these are hardly more than 100 years old. This is shown by the fact that modern types of harpoon heads and other implements as well as metal are found in the old houses by the Eskimos, who are busily engaged in digging them up for the wood and blubber-soaked refuse they contain, which, because of the extreme scarcity of drift-wood, they are forced to use as fuel.

The greater part of the time at Point Hope was devoted to excavating an old cemetery and taking measurements of the natives. From the cemetery were obtained more than 50 well-preserved skeletons. These were original inhumations and did not represent collapsed platform burials. They date from a period, probably several hundred years ago, when platform burial had not been adopted. Very few objects accompanied the burials but it was interesting to find that over the feet of many of them had been placed large fragments, usually the bottoms, of heavy earthenware cooking pots or lamps.

After a quick trip to Point Barrow the *Northland* returned and picked us up again. The first stop on the way south was made at Kivalena where more Eskimos were measured. On entering Bering



FIG. 134.—Eskimo house of walrus skins, Lutke Harbor, northeastern Siberia. The Siberian Eskimo and those on St. Lawrence Island have adopted this type of house from the Chukchee in recent years.



FIG. 135.—Closely flexed burial at Kowieruk, Seward Peninsula. The other burials at this place were extended. Pottery lamp at feet.

Strait we proceeded to Lutke Harbor, in Siberia, to water ship. Here an opportunity was afforded to observe the Siberian Eskimos who are of the same stock as the St. Lawrence Islanders.

We next made a brief stop at the little Diomed Island in the center of Bering Strait. In ancient times this small island was apparently one of the highest centers of development of the old Bering Sea culture and I was fortunate in being able to buy a dozen beautifully decorated specimens of this period that had been excavated by the Eskimos.

Arriving at Nome, Mr. Brandt and I left the ship and made a trip 125 miles into the interior of Seward Peninsula to the upper Kougaruk River. The object was to investigate certain large perforated and notched stones that were reported to have been found in the gold-bearing gravels of Pleistocene age in the Henry Creek mining district. About 16 of these stones have been found, weighing from 10 to 70 pounds. Their most probable use was that of canoe or net anchors or weights to hold down skin roof coverings. The notches and perforations were unmistakably artificial and were as deeply patinated as the adjoining surfaces. Unfortunately we did not ourselves find any of the stones in place. If they really belong in the Pleistocene gravels it is of course a matter of first importance. However, they could easily have fallen down to the gravel unnoticed during the mining operations, while the overburden of tundra and frozen muck was being removed hydraulically. On the other hand, even if they were merely embedded in the tundra it is somewhat difficult to explain their presence, for Henry Creek and the upper Kougaruk, both shallow mountain streams, are 50 miles or more from the sea and there is no evidence that the Seward Peninsula Eskimo ever penetrated into the region unless occasionally while hunting caribou. They might possibly represent an early inland phase of Eskimo culture similar to that found further east and north. However, speculation as to the meaning of the stones is useless until definite knowledge is had of the strata in which they properly belong.

Returning to Nome we once more boarded the *Northland* and after brief stops at Gambell and Sevunga on St. Lawrence Island, got off at Teller. From there a trip was made to Kowieruk, an old village just above the entrance to Imaruk Basin. No evidence of the old Bering Sea culture was found in the excavations although a number of skeletons 100 years old or more were collected. Suggestive of Point Hope was the presence of pottery lamps at the feet of some of the skeletons.

After collecting skeletal material from Akeevenuk, a somewhat more recent site near Teller, we returned to Nome and a few days later started eastward toward Norton Bay in the little schooner *Jewell Guard*. At Koyuk, at the upper end of Norton Bay, we obtained a dozen or more skeletons probably 100 years old. Excavations were next made at an abandoned village on Cape Denbeigh. This appears to be the oldest Eskimo site yet discovered in Norton Sound but it is not so old as those on St. Lawrence Island and at other places around Bering Strait.

Archeological investigations in Northwestern Alaska during the past four years have revealed facts which make it possible to begin to interpret the main trends of Alaskan prehistory. First, there is shown to have lived in Alaska and northeastern Siberia in very early times a group of Eskimo who possessed a highly specialized culture based primarily on the hunting of whales, seal, and walrus. They lived in large semisubterranean houses constructed of driftwood and whale bones and possessed an advanced material culture and an art far richer and more elaborate than any since known to the Arctic regions. This ancient culture has been found on St. Lawrence and the Diomed Islands, Cape Prince of Wales, Point Hope, Point Barrow, and at several localities in northeastern Siberia. We may also expect to find it at Kotzebue Sound and other places between Point Barrow and Bering Strait. It does not, however, seem to have extended eastward to Norton Sound or southward, in its typical form, below St. Lawrence Island.

At some unknown period, probably more than 500 years ago, the rich curvilinear art that was one of the most characteristic features of the old culture was succeeded by another similar to it in certain respects but on the other hand more closely resembling that of the modern Alaskan Eskimo. This later simplified art has been found at St. Lawrence and Punuk islands, the Little Diomed Island, and Point Hope. The designs were executed with metal tools even though stone blades for knives, harpoons, and adzes were still the predominating forms. It seems probable that the change in art was directly due to the introduction of small quantities of metal, possibly from some Oriental source long before the arrival of the Russians into Northeastern Siberia. Some time before the discovery of Alaska by the Russians this intermediate form of art was likewise discontinued, to be replaced by the well known and still simpler art of the modern Alaskan Eskimo. The changes in Eskimo art that can as yet be traced, therefore, have been entirely in the line of simplification or even degeneration.

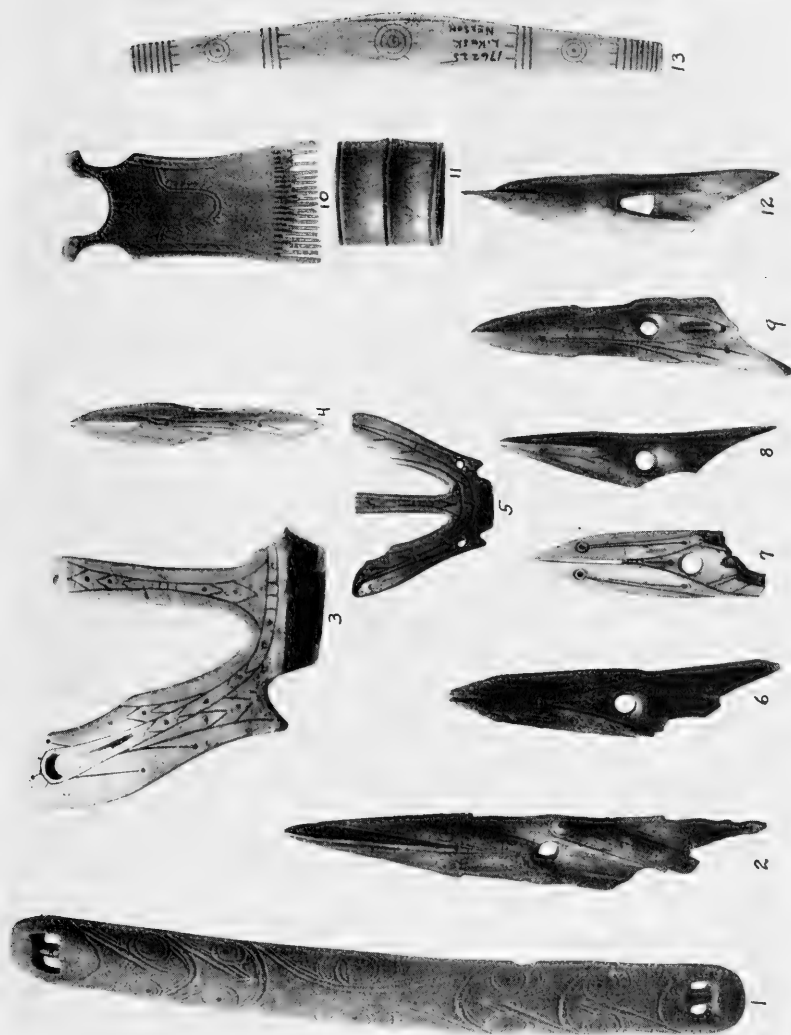


FIG. 136.—Objects of bone and ivory with incised designs representing the three stages of Alaskan Eskimo art. 1-2, old curvilinear art; 3-9, intermediate type; 10-13, modern.

The earlier phase of the old Bering Sea culture, that characterized by the rich curvilinear art, appears without doubt to be the most ancient stage of Eskimo culture of which there is tangible evidence. The oldest Eskimo culture of Canada and Greenland, the Thule culture, was apparently derived from that of Alaska but it is significant that it resembles the late prehistoric and even modern Alaskan culture more closely than it does the earlier Bering Sea culture. It is probable that these resemblances are the result of a return migration or spread of Thule elements subsequent to the original eastward movement of the Thule culture.

Of equal importance, though as yet much less clear, is the question of the relation of the old Bering Sea culture to that of southeastern Alaska and the coast of British Columbia. All that can be said at the present stage of our knowledge is that there is a vague general similarity in the art of the two regions which suggests that further studies may possibly reveal evidences of a former relationship.

The most important task awaiting archeological research in the Arctic or sub-Arctic is to trace the early stages through which the old Bering Sea culture passed. We find it in Alaska as an already highly developed culture, apparently having reached there in that condition. Evidence both of a direct and indirect nature points to northeastern Siberia, somewhere between the Anadyr and Kolyma Rivers, as the probable place of origin of this most ancient known form of Eskimo culture.

PREHISTORIC INHABITANTS OF THE DOMINICAN REPUBLIC

BY HERBERT W. KRIEGER,

Curator, Division of Ethnology, U. S. National Museum

The aborigines of the ancient island of Hispaniola were practically exterminated within two decades following the Conquest. Opportunity for studying their ethnology at first hand therefore does not exist and the scanty literature dealing with native life is in part still buried in Spanish archives. Of first importance is a monograph of a certain Catalan priest, Ramon Pane, who was authorized by Columbus to study the ceremonial life and religious practices of the inhabitants of the great central plain, known as the Vega (meadow). Pane's studies are accurate, for he lived among the natives and spoke their language. A summary of his monograph appears in Volume II of Churchill's Collection of Voyages along with a biography of Columbus written by his son Ferdinand. Other useful records of native culture have been published by the Hakluyt Society of London; of these, the "letters" and the "journal" of Columbus are perhaps the more important. Doctor Chanca's account of the second voyage of Columbus, the historical writings of Las Casas, the "decades" of Peter Martyr, and the works of Herrera and Benzoni give a sketchy account of the historical tribes as they existed at the beginning of the 16th century.

When the Spanish explorers entered on the scene, a great struggle was under way in the West Indies between roving bands of piratical Caribs and peaceful Arawak fishermen and farmers. The Caribs had succeeded in displacing the island Arawak on the smaller islands of the West Indian group nearer the South American mainland before the arrival of the Spanish in 1492, but Arawak resistance stiffened as they became acquainted with Carib practices and learned from them the use of the bow. No Carib raiders were ever encountered by the Spanish west of Porto Rico. It is also significant that the aboriginal Arawak population of Cuba, western Haiti, and Jamaica were unacquainted with the use of the bow.

With the object of studying aboriginal culture remains in the shell- and kitchenmiddens of northern Santo Domingo, the writer was detailed by the Smithsonian to conduct archeological investigations in the provinces of Monte Christi and Samaná of the Dominican Re-



FIG. 137.—The beautiful plaza of Puerto Plata on the north coast of the Dominican Republic. The streets of this town are well improved, the public buildings substantial and dignified, and its plazas are strikingly ornamental. Puerto Plata has lived through 400 years of stormy history and an uncounted number of revolutions.



FIG. 138.—View from the harbor of Puerto Plata. The mountain barrier in the background is scaled by a railroad with one of the steepest track gradients in the world. The automobile highway from Puerto Plata to Santiago in the great central Vega (meadow) in crossing the same mountains provides views of scenic splendor.

public. This work was made possible through the generosity of Dr. W. L. Abbott, whose interest in Antillean archeology is of long standing. The work undertaken during the current year is in continuation of archeological and historical investigations conducted by the National Museum in the province of Samaná in 1928.

From January to May, 1929, excavations were continued at aboriginal village sites in Monte Cristi Province. Three sites were explored in the foothills southeast of the town of Monte Cristi. Their location is perhaps better described as being midway between the fishing village of Petit Salinas on the Atlantic Coast east of Monte Cristi and the pueblo of El Duro on the Monte Cristi-Santiago highway.

The country southeast of Monte Cristi is poorly watered. A few houses of goatherds and of beekeepers dot the 40-kilometer-wide area otherwise entirely unoccupied. Absence of any continuous source of fresh water precludes the extensive settlement of this drought-stricken region. The discovery therefore of extensive aboriginal, presumably prehistoric village sites within this area is all the more remarkable.

The first site explored by the Smithsonian expedition, designated Kilometer 2 by the writer, is approximately 10 kilometers inland from the Atlantic coast, due south of the pueblo of Petit Salinas and 30 kilometers north of the Yaque River, the sole source of fresh water in the lower valley. For a brief period following the rainy season, in December and January, springs from water stored in the subsoil of the foothills afforded a source of water supply. During the remainder of the year a series of artificial reservoirs with earthen dams provided water for the aboriginal occupants of the village. Ruins of these reservoirs although overgrown with thorn thickets, are readily discernible on the lower ground southeast of the village. The aboriginal practice of impounding water in reservoirs during the rainy season is continued by the few Dominicans who live in this semiarid region. Kilometer 2 site includes six parallel rows of refuse heaps and kitchenmiddens extending 350 feet north and south. Ashes from the different aboriginal hearth fires form layers extending practically the entire length of each row. Each midden is separated from the next adjoining midden by the distance of 5 to 10 paces. It would appear that these conditions should have been reversed—that there should be an uninterrupted sequence of midden deposits with clearly marked hearths. This condition, no doubt, is due to weathering and to the wearing away of the upper portions of the cultural deposits by occasional floods and the periodic downpours during the rainy season. Cultural deposits of ashes and of kitchen refuse on the average never



FIG. 139.—Dominican laborers excavating a prehistoric Indian village site in the thorn forest area of Monte Cristi province. Kitchenmiddens and shell heaps in Santo Domingo are never very deep but are frequently extensive. This one extended for more than 300 feet in a south-north direction.



FIG. 140.—Laborer types in Monte Cristi. The old man second from the right, although living within sight of the ocean, had never been aboard a boat. The tall man in the center shows no trace of Negro blood; likewise the man at the left, whose Semitic cast is marked.



FIG. 142.—One of the limestone islets off the south shore of Samaná Bay. Wave cutting has progressed to the stage where the entire islet is about to disappear by toppling into the waters of the bay.



FIG. 141.—A large cactus growing on top of a prehistoric Indian village site. History begins early in Santo Domingo and it would be interesting to compare the approximate age of this cactus with the known date of the extermination of the native Indians by the Spanish colonists.

exceeded a depth of seven feet. Only a few inches of soil covered the middens.

Another aboriginal village site, higher up in the foothills of the Monte Cristi range near the Dominican pueblos of Manantial and Las Aguitas, is much larger than the site designated as Kilometer 2. The presence there of fresh water springs throughout a portion of the year accounts for the presence of such a large aboriginal population. The site extends to the very summit of the highest hills of the region at an elevation exceeding 200 meters. Many of the higher hills of the Monte Cristi range have at their summit small deposits of conchs and other mollusk shells embedded in layers of ash from aboriginal hearths.

Bones of mammals, birds, fish, and also of the sea turtle and the sea cow or manatee occur in quantity throughout the Monte Cristi middens. The relative proportion of fish and of mammal bones identify the former occupants of these sites as fishermen rather than hunters. This observation is significant in considering the distance from the sea. Not only bone, but coral and shell were used and shaped into tools and implements, or into ceremonial objects and objects of personal adornment by the aboriginal occupants of the region. In fact, celts or adzes of conch shell (*Strombus* sp.) recovered by the expedition outnumbered those shaped from stone. For grating the roots of the manioc to produce flour for bread making, slabs of brain coral (*Meandrina* sp.) were carried the long distance from the sea shore. Many such improvised graters were uncovered at each of the sites investigated. Coral was also used in the carved pestles, and in the effigy figurines which probably served as religious objects. With regard to implements and decorative objects generally, shell and bone appear to have been the favored media. This extensive use of shell and bone in preference to stone or wood appears to have extended along the entire northern coast of Santo Domingo. Uniformity in the coast culture of northern Santo Domingo as contrasted with that of other sections of the island is substantiated in pottery finds from the same area. The Ciguayan Indians of Samaná apparently were the occupants of the aboriginal village sites of Monte Cristi Province as well. At no archeological station however along the entire northern coast of Santo Domingo were middens discovered resembling those from the caves of Samaná Bay. Apparently then, the pre-Arawak cave dwellers had never become established throughout the island except in certain favored sections having many caves in the vicinity of salt water.



FIG. 143.—The faithful Abraham at work in shell middens of San Gabriel, an island cave in Samaná Bay. The prehistoric occupants of the Samaná caves did not hunt or engage in agriculture. Mollusks were eaten for breakfast, lunch, and dinner. An occasional turtle provided variety in their diet.

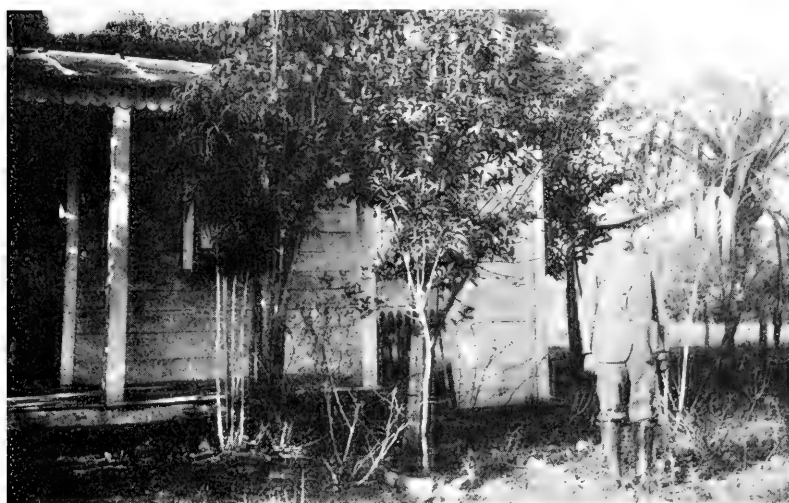


FIG. 144.—The summer home of Señor Andres Socias of Copey, province of Monte Cristi. Señor Socias, who may be seen standing at the right, is an enthusiastic archeologist. His collection of Indian relics is the largest in the island next to that of the National Museum in Santo Domingo City.

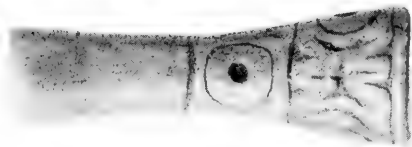


FIG. 145.—A small pectle carved from the rib of a manatee or sea cow. Notice the "circle and dot" design, a protean form of line etching frequently incised by primitive people on such media as shell, bone, ivory, etc. It probably in this case represents an eye.

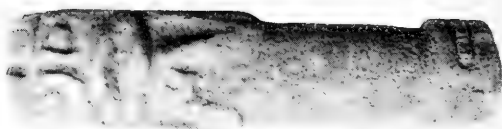


FIG. 146.—A "zemi" or idol used as an amulet by the prehistoric occupants of northern Santo Domingo. The wide distribution of this form of "zemi" carving indicates the correspondingly wide range of a primitive religion in which this spirit carving played a rôle.



FIG. 147.—A gorget or pendant carved from the lip of a conch shell. It is not known what the figure carved from the center is intended to represent. Shell gorgets somewhat similarly carved have been recovered from Tennessee, Missouri, and elsewhere in the southeastern states.



FIG. 148.—Three objects of beaten gold. The gold ornaments of the prehistoric tribes of Santo Domingo are of thin gold leaf. Craftsmanship in metals on their part did not equal that of aboriginal Central or South America. It resembled rather that of the tribes of Florida.

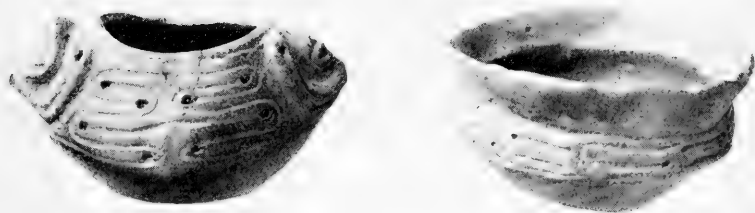


FIG. 149.—Typical earthenware vessels from the province of Monte Cristi. The decorative design consists of meandered or straight incised lines terminating in a pit; also of modeled figurine heads. The pottery of Santo Domingo resembles that of the southeastern United States but appears to be derived from the Mexican archaic.

After concluding explorations at the Monte Cristi sites, a visit was made into the foothills of the central cordillera near the Haitian border in the vicinity of the Chaquey River. The writer was accompanied by Señor Andres Socias of Copey, who had discovered petroglyphs on some large boulders on the banks of the Chaquey River near the village of Mara. The writer also seized the opportunity of studying the large collection of stone implements and ceremonial objects assembled by Señor Socias from northwestern Santo Domingo, west of the valley of the Yaque River. This region apparently constituted the eastern boundary of the aboriginal province of Marien, whose chief, Goacanagaric, befriended Columbus during his first voyage. One of the striking differences observed between Señor Socias' collection from Marien and the objects recovered by the writer from Ciguayan sites east of the Yaque River has to do with stone implements associated with the growing of maize. The Ciguayans east of the Yaque River apparently did not grow maize and no stone implements for working maize kernels into flour were found by the writer. In Señor Socias' collection from northwestern Hispaniola, also in collections from village sites in the great central plain, east of Santiago de los Caballeros, mealing stones similar to the Mexican metate and mano are common. In either area, however, occur flat circular earthenware griddles showing the universal use of cassava bread.

The ceremonial life of the culturally more advanced Arawak tribes of central and western Santo Domingo is characterized by the presence of circular courts walled with stone slabs. The largest of these courts is near the town of San Juan in the province of Azua. This court was described by the great explorer Sir Robert Schomburgk in 1851. A smaller circular court was discovered by the writer in the hills near the headwaters of the Chaquey River. A circle of upright stones, 300 feet in diameter, surrounds a flat space overlooking the valley. Two entrances to the court are placed at opposite sides of the circle. At the exact center stands a stone pillar uncarved except at the top which has been shaped to represent the head of a god or "zemi" in human form. Although the stone-walled court is after a fashion monumental, it does not compare structurally with the more elaborate ball courts of the Maya.

Acknowledgment is hereby made to the many officials of the Dominican government who have extended valuable aid in locating archeological sites. Especial thanks are due to the Honorable Secretary of the Interior, Doctor Alfonseca, for letters of introduction and for obtaining the cooperation of many local officials.

DATING OUR PREHISTORIC PUEBLO RUINS¹

By NEIL M. JUDD,

Curator, Division of American Archeology, U. S. National Museum

For the first time, Indian villages lying within the present United States and abandoned prior to 1492 have been dated, definitely and absolutely. No other recent contribution to American archeology offers such far-reaching possibilities as this; none other has been so long awaited by students of prehistory. And the methods by which those ruined villages have finally been dated with reference to our own calendar smack somewhat of Sherlock Holmes, his inseparable pipe and reading glass. Archeologists must, perforce, be detectives as they follow back along the cold trails of primitive man's advance.

In the present instance, however, the real contribution was made not by an archeologist but by an astronomer whose knowledge and infinite patience were commandeered for the purpose by archeologists. Dr. A. E. Douglass, Director of Steward Observatory, University of Arizona, is the astronomer in question; annual growth rings in Arizona pines comprise the text in which he reads both the age of two score Indian towns long since deserted and the variations of climate for over 1200 years. Through the researches of Doctor Douglass our calendar, at least for the southwestern United States, has been extended to A. D. 700.

The history of the New World, as popularly conceived in this country, begins with the voyages of Columbus; all that transpired before is prehistoric. To be sure, Icelandic sagas tell of discoveries by Eric the Red and Thorfinn Karlsefni when the eleventh century was still in its cradle, but these pioneer journeyings to the bleak Labrador coast seem to many insufficiently supported by documentary proof. Hence our common tendency to credit Columbus with having laid the foundations on which the written history of the western hemisphere has since been piled.

Now the archeologist, as a retriever and interpreter of dead civilizations, is vitally concerned with the age of the people he studies. He seeks always to draw them out of the opaque past and make them part of that better illuminated story which traces the recorded achievements of mankind. Rarely, however, does the archeologist find in his

¹Excepting that of Betatakin, all photographs are reproduced by courtesy of the National Geographic Society.



FIG. 150.—As the largest and most important village in Chaco Canyon, New Mexico, between 910 and 1130, A. D., Pueblo Bonito exerted an influence felt among primitive peoples on the Pacific Coast and the more distant valleys of central Mexico.

digging factors that may actually be correlated with known human events. Especially is this so in the New World where only the Maya erected datable monuments.

Within the United States divers Indian civilizations had taken root, blossomed, and disintegrated before Columbus was born. To mention but two, there are the so-called Mound Builders of the Mississippi Valley and the pre-Hispanic Pueblos of the Southwest. From fragments of their material culture, we have learned much of these dissimilar peoples and their individual accomplishments; we have even pieced together bits of information pertaining to their religious concepts—the very hub on which their daily life revolved. But until the close of 1929 we had no means of knowing accurately the years during which these native cultures flourished.

From 1921 to 1927 it was my privilege to conduct explorations for the National Geographic Society at Pueblo Bonito, most famous, perhaps, of the great communal centers which mark the very apex of Pueblo civilization. The architectural development of Pueblo Bonito; the material culture of its, 1,200 or more inhabitants; their conquest of a semi-arid environment and their defeat, in turn, by forces quite beyond their control have been briefly presented in earlier numbers of this series.¹ But the age of Pueblo Bonito, the years of its rise and fall, remained until recently a matter of conjecture only.

Of course there were relative dates, determined by a balancing of the evidence in hand. We knew, for example, that Pueblo Bonito was older than the now ruined Hopi settlements visited by Pedro de Tobar and Fray Juan de Padilla, of Coronado's command, in 1540; we knew it was younger than hundreds of small communities throughout the San Juan drainage, and elsewhere. This knowledge acted merely as a spur toward more precise information. We wanted at least one definite year. And we finally got it, and much more, after seven years' painstaking research along dim trails that led us far from our starting point.

It was on December 8, 1922, at a conference called by the Carnegie Institution of Washington to consider cyclic phenomena that I first heard Doctor Douglass describe his use of tree rings in tracing sun-spot influence. As a mere by-product of his studies, Doctor Douglass mentioned the fact that in examining sections of prehistoric beams sent him from Pueblo Bonito and Aztec ruins, in New Mexico,

¹ Smithsonian Misc. Coll., Vol. 72, Nos. 6 and 15; Vol. 74, No. 5; Vol. 76, No. 10; Vol. 77, No. 2; Vol. 78, Nos. 1 and 7; *Explorations and Field-Work of the Smithsonian Institution in 1927*.



FIG. 151.—Charred beams from the broken walls of Pueblo Bonito disclose extensive reconstruction, in A. D. 1067.



FIG. 152.—More than 200 young pines were felled in A. D. 1061 to roof this single Pueblo Bonito kiva.

he had noted a cross identification which showed that the Pueblo Bonito specimens were cut just 20 years earlier than those from Aztec. Now it occurred to me at the moment that if it were possible to determine the time relationship of two ancient buildings from their ceiling timbers it was also possible, provided beams could be found in a succession of ruins varying slightly in age, to bring together a sequence of annual growth rings that would extend back to the charred logs of Pueblo Bonito and thus disclose the actual year in which they were felled. This chance thought served as a stimulus.

Assured of Doctor Douglass' cooperation, the Research Committee of the National Geographic Society provided for a beam collecting expedition in 1923, under my general supervision, and for subsequent laboratory investigations. The age of Pueblo Bonito was the sole objective. But that objective proved most elusive; it was pursued vigorously throughout the entire plateau country and down to California. Naturally, the timbers from each site visited gave an independent ring sequence but these were gradually joined into a continuous record of 586 years. Another series, from living pine forests near Flagstaff, Arizona, extended from 1925 back to A. D. 1425. Next came the task of joining the modern rings with the longer, prehistoric series. More material was needed and this must be pine, the only medium in which Doctor Douglass could work with confidence.

There followed a second expedition, in 1928, which confined its efforts largely to the Hopi villages of north-central Arizona. Spanish chronicles tell of missions constructed there during the first half of the seventeenth century; Hopi traditions relate the destruction of those missions during the Pueblo revolt of 1680. Carved Spanish timbers were visible in certain Hopi kivas, the subterranean chambers in which ceremonies were performed by members of male societies. There was just a chance that, among the largest of these pine beams, at least one might be found whose rings would reach back beyond our modern series to connect with the older.

Briefly, the 1928 season produced two notable results: It extended Doctor Douglass' Flagstaff records to A. D. 1260 and it pointed out the localities in which twelfth and thirteenth century ruins rightfully should exist. The chief difficulty lay in the fact that such ruins, built in the open, were exposed to the elements; that their roofing timbers, unless preserved as charcoal, could not possibly have survived until the present. Therefore, to cross-date with material already in hand, search must be made for a settlement constructed about 1275 and subsequently destroyed by a fire which had been smothered by falling



FIG. 153.—Walpi, like the other Hopi villages, was transferred to its present elevated site following the Pueblo revolt of 1680.



FIG. 154.—Of all the Hopi towns only Oraibi, now rapidly falling into decay, appears still to occupy its original fifteenth century location.



FIG. 156.—Two hundred years after White House pueblo was erected in Canyon de Chelly, Mesa Verde clans came to reoccupy it, in A. D. 1275.



FIG. 155.—Constructed in A. D. 1260-1277, Betatakin was almost the last of northern Arizona's picturesque cliff-dwellings.

masonry before the wood on which it fed was wholly consumed. More detective work!

The third beam expedition, that of 1929, had its nose close to the ground. With potsherds serving as guides, members of the party¹ visited a dozen or more sites of the desired age. Some of these were too far from living pines to warrant serious consideration, for pine only could be used with certainty in our studies and where pines now stand there, most assuredly, pines formerly stood. Other ruins were so vast or so utterly demolished and overblown by drifting sand that location of burned rooms was too largely a matter of chance, considering the time and funds at our disposal. But, from among the number, two old villages down among the pine forests bordering the Mogollon Rim, in Navajo County, Arizona, were finally selected. The choice proved a happy one for, with a minimum of effort, these two ruins, at Showlow and Pinedale, respectively, provided the charred fragments of ceiling beams which convincingly bridged the gap separating the modern and the prehistoric ring sequences and brought to successful conclusion investigations which had their inception in a Washington conference on entirely unrelated matters.

Thus, primarily through the researches of Doctor Douglass, aided by several of my archeological co-workers, the National Geographic Society has made an unparalleled contribution by extending United States history nearly six centuries beyond Columbus' voyage of 1492. The earliest beam recovered from Pueblo Bonito was cut in A. D. 919, the very year when German nobles were choosing Henry I as their king; the latest timber represented in our collection from this ruin was felled in 1130. For reasons quite unknown to us the Bonitians developed a reconstruction complex about A. D. 1070 and, wholly unconscious of the ruthless sword William the Conqueror was then swinging throughout England, instituted extensive alterations within their four-storied, communal home in Chaco Canyon. Like other Pueblo groups, the Bonitians were peaceful farmer-folk; they practiced a democratic form of self government 700 years before the Pilgrim Fathers dropped anchor off Provincetown in 1620. The

¹ Dr. Douglass and the writer; Dr. Harold S. Colton, Director of the Museum of Northern Arizona, at Flagstaff, and Lyndon L. Hargrave of the same institution. The services of Mr. Hargrave, well versed in Hopi prehistory, were generously placed at our disposal by Dr. Colton and his Board of Trustees—a courtesy inadequately acknowledged by this brief reference.

The later excavations at Showlow and Pinedale were supervised by Mr. Emil W. Haury, of Arizona State University; those at Wide Ruin and Kokopnyama, by Mr. Hargrave and his assistant, Mr. E. C. Greene, Jr.



FIG. 157.—The cliff-dwellings of Mummy Cave, in Canyon del Muerto, Arizona, were built in A. D. 1253-1284 upon the superimposed rubbish of four earlier stages of communal development.



FIG. 158.—A single, fragmentary beam from Cliff Palace, Mesa Verde National Park, Colorado, gave the date A. D. 1073, but the village probably was still inhabited a hundred years later.

Bonitians, like other Pueblo builders, added to their terraced town as necessity required. They razed and replaced dwellings with surprising disregard of the physical labor involved; logs they felled and trimmed with stone axes were used over and over again. As evidence of conservative Pueblo habits it is interesting to note that, in Oraibi, Doctor Douglass uncovered a pine timber which had been utilized more than 500 years.

That the better informed archeologists, tracing the development and spread of Pueblo civilization, know whereof they spoke is well indicated by the Douglass tree-ring chronology. For example, Cliff Palace, in the Mesa Verde National Park, Colorado, was recognized by many as among the oldest major cliff-dwellings of the Southwest yet distinctly younger than Pueblo Bonito; Betatakin and Keet Seel, out in the northern Navajo country, were regarded by the same authorities as perhaps the last inhabited cave ruins of the San Juan drainage. Now we know absolutely, from the mute record of their ceiling beams, that at least one log was cut for Cliff Palace in A. D. 1073; that Spruce Tree House was inhabited nearly two centuries later; that White House pueblo, in Canyon de Chelly, dates from 1060 to 1275; that 13 timbers were felled for Betatakin during the 17 years following A. D. 1260; that the seven Keet Seel logs represented in our collection were cut in the decade beginning 1274.

Thus in seeking the date of Pueblo Bonito, the National Geographic Society expeditions have ascertained the ages of approximately 40 other ruins. Given beam samples, charred or otherwise, with outside ring intact, almost any prehistoric southwestern settlement may be brought within our modern calendar by the Douglass chronology. Material is already in hand from Basket Maker sites; from Pueblo I pit dwellings. It remains only to bridge the gap between them and the oldest annual growth ring found in Pueblo Bonito before we can time the beginnings of sedentary life in the Southwest and the inception of agriculture.

In the December, 1929, issue of the *National Geographic Magazine* Doctor Douglass tells the story of the Society's three beam expeditions and something of their results. His more complete presentation, including a description of methods, will accompany my own report on the Pueblo Bonito explorations, now in preparation. Not until this latter volume is issued can adequate recognition be given those several individuals who have generously contributed to the success of this magnificent undertaking.

ARIZONA SACRIFICES HER PREHISTORIC CANALS¹

By NEIL M. JUDD,

Curator, Division of American Archeology, U. S. National Museum

What now remains of the justly famous prehistoric canals of the Salt and Gila river valleys, Arizona? To answer that question for the Bureau of American Ethnology I paid a hasty visit to the areas in question in mid-September, 1929.

Most of us are prone to forget that what formerly comprised the the most extensive irrigation projects in the Americas, if not, indeed, in the whole world, were undertaken by primitive farmers of south-central Arizona. No where else, so far as I am aware, had similar operations on so vast a scale been attempted prior to the present era of steam shovels and drag-line dredges

In 1893 Mr. Frederick W. Hodge, formerly of the Smithsonian Institution and a member of the Hemenway Archaeological Expeditions of 1886-8, wrote: ". . . the principal canals constructed and used by the ancient inhabitants of the Salado valley controlled the irrigation of at least 250,000 acres . . . at least 150 miles of ancient main irrigating ditches may readily be traced, some of which meander southward from the river a distance of 14 miles." ²

Less trustworthy observers have even doubled the above figures; on the basis of the acreage supposedly cultivated, have estimated a prehistoric population as high as 200,000. Now the value of such estimates varies directly with the experience and qualifications of the individual reporter. Numerous factors must be taken into consideration. Not every passerby can view the divers works of prehistoric man with the calm impartiality of the trained archeologist. For my own part, I have no first hand opinion to express as to the original number and extent of Arizona's ancient canals. They were mostly gone when I went to see them. And most of the references pertaining to them do raise doubts of one sort or another.

But let us assume that Mr. Hodge is substantially correct. One hundred and fifty miles of canals averaging seven feet deep and thirty

¹ Photographs by courtesy of the National Geographic Society.

² Prehistoric Irrigation in Arizona. *The American Anthropologist*, Vol. 6, No. 3, pp. 323-330. Washington, 1893. Earlier references to this subject are noted by Dr. O. A. Turney in a continuing article, "Prehistoric Irrigation," published in *The Arizona Historical Review*, Vol. 2, 1929.



FIG. 159.—One of the prehistoric canals preserved by Phoenix, Arizona, in its Park of the Four Waters.



FIG. 160.—An ancient canal, at the upper right, was bisected by Salt River long before the Swilling ditch, in the foreground, was dug about 1868.

feet wide is no mean achievement for a primitive people without beasts of burden; with no excavating equipment other than stone and wooden implements. We have as yet no certain knowledge as to just what Indian groups accomplished this stupendous task but we do know, from archeological deductions, that the work was done by hand and that small baskets were the most likely containers employed in the removal of excavated material.

If, as contractors insist, a husky laborer can pick down and shovel into waiting cars 12 cubic yards of loosely-cemented gravel in an eight-hour working day, then anyone so inclined may figure the time



FIG. 161.—Pima children, no doubt, had constructed a pebble maze on the floor of Canal Fourteen during the summer of 1929.

involved in the construction of the Salt River valley canals. I have not done it for several reasons: for one, I have no statistics on the relative efficiency of an eight-pound steel pick and a river cobblestone, sharpened by the flaking process and used as a grubbing tool. But I do know the average Indian farmer of the Southwest is at his self-appointed tasks from sunrise to sunset when necessary and I know, further, that same Indian will accomplish more in his own behalf than he will for any employer. With stone and wooden tools; with baskets as precursors of wheelbarrows, the native populations of the Salt and Gila river valleys performed tasks the very magnitude of which astonish us of a mechanical age.

Arizona's prehistoric canals were not individual enterprises. Entire communities joined hands to achieve that on which their very existence depended. By preference, these folk were farmers in a desert environment. They waged a constant struggle against seemingly insuperable odds; asked no favors; required no cornucopia for contentment. But without successful harvests their immediate future loomed darkly; without water, food crops could not mature; without canals, water could not be conveyed to fields suitable for cultivation. Canals meant water and water meant life. Hence those man-made ditches that reached into the river channels with flimsy brush and stone dams and meandered down valley long miles to isolated villages whose dun adobe dwellings clustered about a massive edifice of thick, earthen walls.

In 1926 Dr. Byron Cummings, Director of the Arizona State Museum, surveyed 40-odd miles of ancient canals in the Gila River Valley; in 1922, Dr. O. A. Turney, of Phoenix, published¹ his map of the still larger canal systems bordering the Salt River. These timely surveys must find place among our permanent records. They cannot be repeated and it is already too late to check them for possible error. The old canals are mostly gone now, a sacrifice to agriculture and to urban development. Modern homes and office buildings; cotton fields, vineyards and acres of lettuce have recently spread over garden plots where primitive folk cultivated maize, beans and squashes.

Monster dams, named in honor of two ex-presidents, have been raised to impound flood waters which are thereafter equitably distributed, even during the hot dry months, to ever thirsty fields. Newly dug ditches often follow their untimed predecessors in wide curves across the gentle, cacti-covered slopes of the valley. The recent, remarkable increase in population of Phoenix and its neighboring communities is basically owing to a fairly constant water supply conveyed by this far-flung network of modern canals and the consequent, successful cultivation of desert soil.

But this expansion, this evidence of industry has brought with it almost complete obliteration of the prehistoric irrigation systems. These latter made possible the first real civilization in Salt River Valley—a native Indian civilization based on agriculture in which the entire community directly participated. Of the 230 miles of ancient

¹ The Arizona Republican, Phoenix, November 22, 1922; reproduced in "The Land of the Stone Hoe" (Turney), 1924, and in the Arizona Historical Review, Vol. 2, No. 2, 1929. The map supposedly includes the earlier surveys by C. A. Garlick, of the Hemenway Expedition, and that of H. R. Patrick, published in Bull. 1, Phoenix Free Museum, 1903.



FIG. 162.—Near its present junction with Salt River, Canal Fourteen measures 8 feet deep with a maximum width of 66 feet.



FIG. 163.—Greasewood and catchlaw offer no obstacle to the giant grading machines employed on the San Carlos project.

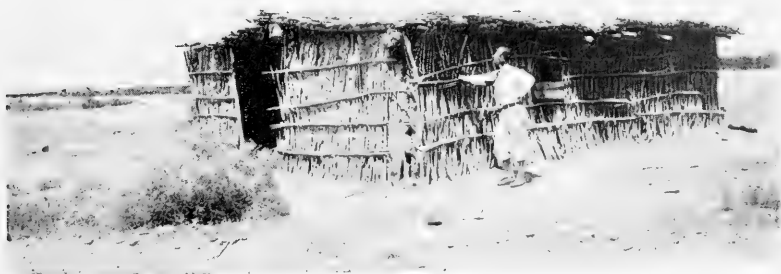


FIG. 164.—Pima houses are usually built of suhuaro cactus ribs, plastered with mud. When their water supply fails, the Pima move.

canals represented on the Turney map, I venture the guess that less than ten per cent are now traceable. And these only because the tractor and the gang-plow have not yet reached them.

In its Park of the Four Waters, the city of Phoenix has happily preserved remnants of three old canals. Eleven miles to the east there remains another magnificent section (fig. 162); vestiges of still others may be seen, if they have not been leveled and plowed over since last September, north of the Sierra Estrella, some 13 miles southwest of Phoenix. Other sections survive here and there but chiefly on Indian lands. The brush and stone dams that originally turned the river current into these ditches were lost with each passing flood; their very sites have since been washed away as the river widened and deepened its pebbled channel. In every instance, I am reasonably sure, the old canals now open their thirsty mouths at least 10 feet above the present water level (fig. 160). But this fact does not of itself necessarily indicate an age of more than 10 or 12 centuries for the canals.

The 50 major buildings and the uncounted lesser structures that Cushing called Los Muertos in 1887 have gone to fill the several old ditches he saw nearby. No trace remains today of this once populous and important settlement. Where it formerly stood, contented cows now munch in green meadows. And what is true here is generally true elsewhere throughout the Salt River Valley.

On the Pima Reservation, south of the Gila, 56,000 acres of virgin land were being prepared in 1929 for Indian farmers. As I happened by, giant tractors were pulling mesquite trees out by the roots; were raking, grading and smoothing the sandy soil at the rate of 20 acres a day. Of the several prehistoric canals which crossed these new fields a year ago, one dim meandering channel alone remained. It, too, was doubtless wholly erased within a few days. Here the engineer is justly proud of the efficiency with which his snorting machines perform; of the speed and sureness with which a colossal undertaking is being consummated. What is past, is past! Lingering vestiges of a prehistoric civilization from which the entire nation might learn are wiped out, destroyed, with a wave of the hand. Like those of the Salt River Valley, the ancient canals bordering the Gila have mostly been sacrificed to twentieth-century hopes. A generation hence, some vague tradition may prevail among the Pima and Papago of vast ancestral canals through which Arizona's formidable deserts were first temporarily vanquished.

Each succeeding civilization builds on the remains of its predecessors!

PREHISTORIC MOUNDS IN THE VICINITY OF TAMPA BAY, FLORIDA

BY M. W. STIRLING,
Chief, Bureau of American Ethnology

In prehistoric times the region around Tampa Bay, Florida, was the site of many villages, the inhabitants of which subsisted principally upon the fish and mollusks which abounded in the shallow waters of the bay. The kitchenmiddens which arose as a result of the accumulation of refuse from these villages constitute the largest shell mounds on the American continent. The writer spent the months of March and April, 1929, in making a survey of the mounds in this neighborhood.

Because of the conspicuous nature of these towering heaps of shells, it is a comparatively simple matter to locate the ancient sites, despite the fact that during the last 75 years countless tons of this material have been hauled away to be used in the construction of roads. In numerous instances mounds more than 30 feet in height and covering many acres of ground have been almost completely obliterated within the past few years. In many cases the houses of the village were constructed upon these refuse heaps, so that their destruction entails also destruction of all traces of the habitations.

During the writer's survey, more than 40 sites were located upon Tampa Bay alone. At the present time but a single example of one of the large shell mounds remains undisturbed. The huge refuse heap on Cockroach Point, rising to an elevation of 50 feet, has escaped the depredations of the road builder because of its comparative inaccessibility. The mound rises in a succession of terraces, each of which was formerly occupied by houses. The flat summit of the mound was undoubtedly crowned by a temple, from which point it is not unlikely that dark-skinned observers watched in fear and wonder the progress of De Soto's ships as they followed the winding channel into Tampa Bay.

In early historical times it is known that this region was occupied by the now extinct Calusa Indians, while immediately to the north dwelt their neighbors, the Timucua. History gives us scant information concerning the language and customs of these tribes. The problem of the archeologist is to find more of their arts and customs from the unintentional record they have left behind in their



FIG. 165.—Ancient village site at Safety Harbor, Florida, now overgrown with dense tangle of vegetation.



FIG. 166.—Mangrove at Cockroach Point, Florida. The elevation at the right corner of the picture is the large mound.



FIG. 167.--The Weeden Island mound showing two burials in place.

burials and refuse heaps, and to discover if possible what people preceded them into this region.

Excavations continued at Weeden Island have finally cast some definite light upon the problem of culture sequence, when a mound containing secondary burials and pottery of an advanced Muskhogean type was found erected over a cemetery which contained primary flexed burials in graves lined with oyster shell and containing only a few fragments of a crude, undecorated pottery.

Preliminary tests were made at the large mounds near Safety Harbor, which reveal a site similar to that on Weeden Island, further excavation of which should add considerably to our knowledge of this culture.

The largest sand mound which the writer has yet seen was located near Palma Sola, and it is hoped this coming winter to conduct excavations at this place. The village to which the mound belonged was situated near the entrance to Tampa Bay, and was probably the largest of all the Tampa Bay sites. Unfortunately the refuse heap, described by old inhabitants as having been the largest of the Florida West Coast, has been almost entirely carried away.

A good beginning has now been made in an area in which very little systematic archeological work has been done. It is hoped that this data, added to that which it is hoped will be accumulated during the next few years, will definitely establish the line between the Calusa and the Timucua, their possible relation to tribes in the north or the West Indies, and to the peoples who preceded them—probably the first discoverers of Florida.

TWO ANCIENT INDIAN CULTURES IN EASTERN ARIZONA

BY FRANK H. H. ROBERTS, JR.,
Archeologist, Bureau of American Ethnology

Early developments in the unfolding of the sedentary Indian cultures of the prehistoric Southwest present a problem upon which considerable archeological interest is centered at the present time. The work of the last 25 years has done much to complete the portion of the story which deals with the later stages, the periods of the great communal houses and massive cliff-dwellings, but preceding chapters are for the most part only outlined. In an effort to supply some of the needed details the writer, assisted by Mr. J. A. Jeançon, former special archeologist for the Bureau of Ethnology, spent the field season of 1929 conducting excavations in eastern Arizona. The site investigated is on the old Long H Ranch, between St. John's and Houck, 40 miles west of the present Indian village of Zuñi.

The locality presents several features of interest besides those of a purely archeological nature. Close to the ranch houses, one half mile from the ruins, are two small lakes to which the Zuñi attribute special ceremonial significance. One is very salty and distinctly red in color (fig. 168), while the other is only slightly salty and has a pronounced green hue. Both were found to figure rather prominently in certain of the Zuñi myths and the writer was informed that quadrennial pilgrimages are made to them for the purpose of depositing prayer plumes and offerings of turquoise. Around the borders of these lakes are a number of fresh water springs which probably were an important factor in the choice of the location by the people whose house and village remains attract the archeologist.

Three miles south of the ruins investigated is a considerable group of petrified logs, probably an eastern outcropping of the petrified forest which lies several miles farther west. Some of the logs, exposed on the surface of the ground, are 50 feet long and from 4 to 5 feet in diameter (fig. 169). In many instances the stone is brightly colored and, judging from the many fragments found in the ruins and refuse mounds, was extensively collected by the prehistoric settlers. Several small ruins in the immediate vicinity show that the builders even went so far as to use blocks of the petrified wood in erecting walls.



FIG. 168.—The red lake, 40 miles west of the Indian village of Zuñi, New Mexico. The background in this picture is characteristic of the region.



FIG. 169.—One of the petrified logs south of the ruins.

The archeological remains proved to be of two types representing distinct horizons. The oldest, pit houses, belong to the very beginnings of the Pueblo cycle, while the more recent represent the fully developed peoples of the Classic Era. The writer had no intention of excavating a ruin of the pueblo type when work was begun on the pit houses, but as investigations progressed he became more and more impressed with the idea that it might be possible to obtain some stratigraphic evidence indicative of the exact relationship between the two groups. With such a possibility in contemplation the débris was removed from a medium sized ruin, the north end of which was found to rest upon and entirely cover the remains of a pit house. This definitely established the priority of the latter form of dwelling.

Information obtained from the ruins of 17 pit houses makes it possible to briefly summarize the main features of such dwellings. They had consisted of roughly circular or oval pits, ranging from 5 to 8 feet in depth and 10 to 25 feet in diameter (figs. 170 and 171), roofed over with a pole, brush, and plaster superstructure supported on four upright posts placed in the floor some distance from the walls. This plaster covered roof was probably only sufficiently elevated above the ground level to provide for drainage. A single opening in the center of the roof served as both smoke hole and entrance. The sides and bottom of the pit, the major portion of the dwelling, were covered with a thick coating of carefully smoothed mud plaster. Interior furnishings were simple. In the center of each room was a fire pit and adjacent to it a depression in which the base end of the ladder, used in entering and leaving the structure, rested. At the southeast side was a ventilator consisting of a short tunnel leading from the room to the bottom of a vertical shaft, the upper end of which opened to the air on the surface of the ground beyond the confines of the house.

The ventilator was just what its name implies. When a fire was burning in the pit in the center of the room the heat rising from it and passing off through the smoke hole at the top would have a tendency to draw fresh, cold air down through the shaft and tunnel and into the room. This same feature is found in the ceremonial chambers, or kivas, of the many roomed houses of later periods. Evidence has shown that the feature was not originally designed for such a purpose but represents a modified survival of the entrance found in older houses, dwellings of the period just preceding that to which the Arizona ruins belong. In most of the houses there was an upright slab of stone set in the floor between the ventilator opening and the fire pit (fig. 170). This is called the deflector and was so



FIG. 170.—Remains of a typical pit house. Opening in center of wall is the ventilator, standing stone the deflector.



FIG. 171.—View of another pit house. Remains of holes for wall poles may be seen at back of bench.



FIG. 172.—Portion of pueblo ruin. Walls in foreground are of adobe, those in the rear show stone construction.

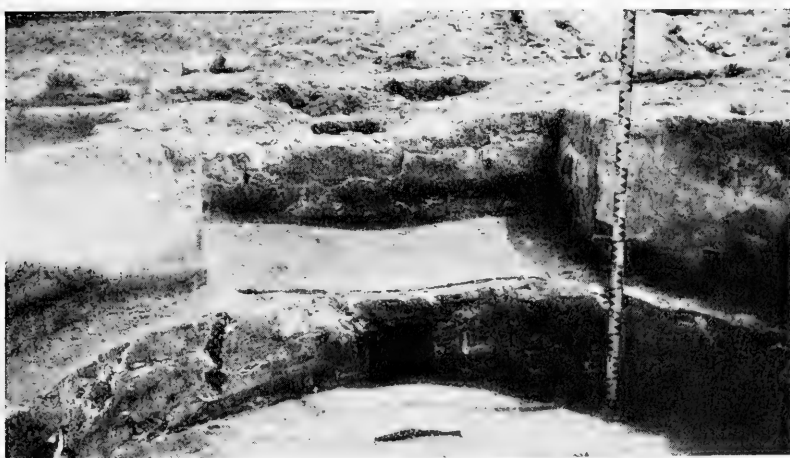


FIG. 173.—Kiva in pueblo ruin showing deep recess above the ventilator opening.

placed to prevent the intruding air from blowing directly on the fire. Many of the rooms had a second stone which could be used to close the vent opening entirely if so desired (fig. 170).

Houses of this type were found in clusters of from four to six, probably representing family or clan units. A number of these units gathered together would constitute a small village.

At the east or southeast side of each unit was a trash mound where the refuse from the houses had been deposited. These mounds had also served as the burial places for the dead. Each interment was accompanied by mortuary offerings of pottery and, as the deceased had been placed in the grave bedecked with articles of personal adornment, many fine specimens of shell bracelets, beads, and pendants were obtained. These articles of material culture together with the information on house types makes possible the drawing of a fairly complete picture of the life of the people during the early period in that district.

The building which belonged to the later period was found to have been an L-shaped structure of 49 rooms and 4 kivas or ceremonial chambers. Its walls were of two types. Some had been constructed of stone, others of adobe mud (fig. 172). That stone was not used throughout was probably due to the scarcity of such material in the immediate neighborhood. This communal house was not erected from a preconceived plan. Four distinct stages in its growth were plainly evident. To a small structure of eight rooms and a kiva, six more rooms and a second kiva were added. Then after a time 10 more rooms and a third kiva were erected. The building as it then stood was occupied for a considerable period before the final group of 25 rooms and the fourth kiva was built.

The refuse mound, also the cemetery, was located a short distance east of the communal structure. Another example of stratigraphic evidence was found here. It was discovered that the waste material, the refuse from the village, had been deposited on and completely covered the mound formed by the filled-in ruins of a pit house cluster. This further demonstrated the greater antiquity of the cruder house types. The burials of this mound were also accompanied by mortuary offerings of various kinds which aid in rounding out the complex of the culture.

Outstanding in the results from the excavations is the evidence that the pit house, a development of an earlier culture, survived in the Pueblo horizon in this district, while in the north, along the San Juan River, people belonging to the same cultural level were building and living in rectangular structures the major portions of which



FIG. 174.—Characteristic pottery from the pit houses.



FIG. 175.—Typical vessels from the pueblo ruin.

were above the surface of the ground. The main feature of interest in the pueblo ruin, in addition to its stratigraphic relationship to the pit houses and the manner in which it illustrates the development and growth of such a communal center, is its suggested relationship to the San Juan cultures in the north. This is clearly shown in the pottery and by the circular ceremonial chambers or kivas. The latter have pilasters to support roof timbers and pronounced wall niches above the ventilators (fig. 173). These characteristics have long been considered typical of the San Juan kivas and have not been thought to have been constructed by peoples living outside that area. Their presence in the Arizona region demonstrates how widespread the northern influence was at that particular period.

STUDYING THE INDIANS OF NEW MEXICO AND CALIFORNIA

By J. P. HARRINGTON,

Ethnologist, Bureau of American Ethnology

Research during the summer of 1929 took me among Indians representing three distinct cultural regions. My first field-work took me to the mountains of New Mexico where further attack was made on the riddle of the Pueblo languages and cultures. Although a considerable knowledge of the native languages and dialects was already current in this region among the Spaniards of the 18th and early 19th centuries, they were never aware of any relationship between these tongues and those of tribes outside the Pueblo area proper. After the classification sponsored by Major Powell over 40 years ago, it became the standard lore of textbooks that the Pueblo Indians speak four stock languages, Tanoan, Keresan, Zuñian, and Shoshonean, and that only the last named has outside affiliations, namely that of the Hopi as related to the Paiute tribes to the north and west and more distantly to the Aztec. When I began my studies of Pueblo languages I early found that Tanoan is closely related to Kiowa, a Plains tribe lying to the eastward of the Tanoan.

This summer's field-work was concerned with Tanoan and Zuñian and to some extent with the language of Acoma. An elaborate comparison was made of the Zuñi and Tanoan languages with the result that the genetic relationship which I have long believed in was definitely established. The phonetics of the two languages are identical throughout. Among other similarities, they both have series of clusives modified by the glottis into three kinds of release, represented by *t*, *t̥*, and *th*. Keresan also shares this system. This and other linguistic similarities are also found in the Shoshonean stock, and I am confident that I have demonstrated that all four "stocks" of Pueblo languages are genetically related to each other in varying degree, although we have here no close relationship like that of the Tanoan to the Kiowa.

A complete Zuñi alphabet of kymograph tracings showing sounds and their combinations was made and mounted and is ready for the engraver. A Zuñi ethnozoology following the same lines as the Tewa ethnozoology earlier published by the Bureau was brought to completion with the help of Miss Anna Risser. The subject of Zuñi ethno-



FIG. 176.—Mrs. Fannie Orcutt, Karuk informant, sister of Salmon Billy, Steven Powers' informant whom he used in writing his "Tribes of California" in the seventies of the past century.



FIG. 177.—Mrs. Ascención Solórsano, the last San Juan informant.

botany met with even more success. Miss Anna O. Shepard made a large collection of plants which have been identified by the National Herbarium. While at Zuñi a version of the creation myth was secured and partly recorded. It is planned to publish this in three columns, Zuñi, Zuñi-Spanish dialect, and English, accompanied by illustrations made by the Indian who told the myth.



FIG. 178.—Bárbara, mother of Mrs. Ascención Solórsano.

Passing from the arid mountains of New Mexico to the forested mountains of northern California, I undertook further work on the Karuk tribe of the lower central Klamath River. I was fortunate in securing as an informant the sister of the famous Salmon Billy who acted as Steven Powers' informant when he was on the Klamath in the early seventies. A rare cycle of songs was obtained from Happy Jack, an old Karuk man. The Karuk work now comprises by far the most exhaustive amount of material that has ever been assembled on a California tribe, including grammar, dictionary, myths, sociology,



FIG. 179.—San Juan Indian blackberrying basket, made by Mrs. Ascención Solórsano. The material is willow and tule. It was lined with sycamore leaves or cutgrass to keep the berries from falling through the interstices. U. S. National Museum Cat. No. 107866.



FIG. 180.—Point of Pines, a typical bit of seacast near Monterey, California, mentioned in the mythology of the San Juan Indians.

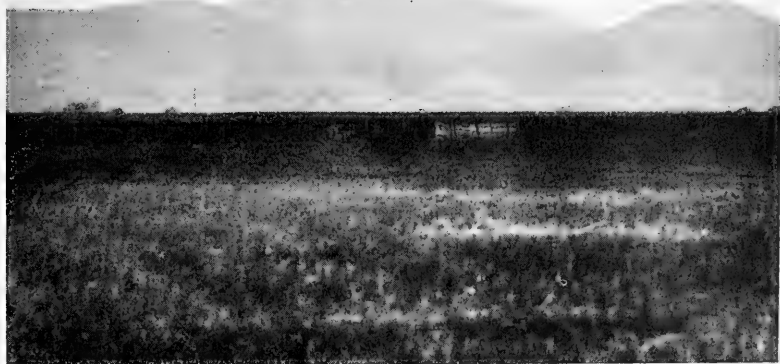


FIG. 181.—Gabilan Peak near San Juan, California.

kinship terms, ceremonies, ethnozoology, ethnobotany, ethnomineralogy, tribenames, placenames, personal names, material culture, daily life, religion, genealogies, and history. All the material has been obtained in text, following the strictly scientific method of obtaining ethnological information.

Without doubt the great triumph of the present field-work has been the complete rescuing of the language and much of the ethnology of the San Juan tribe of California in an almost miraculous way through a very aged and desperately ill informant, Mrs. Ascención Solórsano, at present living in the environs of Monterey. Having learned the language, which has scarcely been spoken since 1850, through the peculiar circumstance that both her mother and father who were fullblooded Indians talked the language together all their lives while no one else was using it, the mother (see fig. 178) dying at 84 years of age and the father at 82, she has retained the knowledge of an extinct language and will live long enough to furnish a complete record of all she knows, thus filling a great blank in California ethnology.

The San Juan are a key tribe, lying midway between the northern and southern California coast cultures. They exhibit many interesting transitory cultural features as exemplified in their basketry, ceremonies, mythology, and other features. We see at one moment similarities to the Pomo; next we are reminded of the peoples to the south. Mrs. Solórsano during a good part of her life has been recognized as a "*doctora*" so that her knowledge of native doctoring practices and of herbs is unusually complete. In spite of her age and infirmities her mind remains remarkably clear while her memory is exceptional, recalling in detail numberless incidents of her childhood at old San Juan. No greater piece of good fortune has ever attended ethnological research in California than this eleventh hour rescue of the language and customs of a once important Indian tribe.

THE "LEAGUE OF NATIONS" OF THE IROQUOIS INDIANS IN CANADA

By J. N. B. HEWITT,

Ethnologist, Bureau of American Ethnology

The Indians of the Six Nations of the Iroquois dwelling in Ontario, Canada, and in the State of New York formed the subject of my field researches during the summer of 1929. My first and longest stop was in the city of Brantford, Ontario, Canada, situated several miles westward from the Grant of land to the Six Nations. Assisted by an Onondaga and a Cayuga informant my first work was a critical revision of the Onondaga texts of nine myths relating to the Air or Wind Gods. This study yielded satisfactory results, not only in the matter of translation and interpretation, but as well in the recovery of the personage of the Echo God, *de'hot'āū*, and also that of the Whistling God, *Djinaga'ihä*, as other members of the aerial hierarchy of Iroquoian mythic thought. From a capable informant, Chief John Buck, Jr., an Onondaga-Tutelo mixed blood, I recorded in Onondaga text a most interesting historical tradition detailing the northward migration of the Tutelo (Siouan) tribe from its southern habitat in Virginia and North Carolina to the country of the Cayuga in what is now the State of New York and the negotiations preceding it. This tradition is of unusual interest because it embodies references to a number of customs and especially intertribal amenities at an early day and customary precautions taken for such a journey of a tribal people through the lands of other hostile peoples. Among the Iroquois similar historical traditions are conspicuous by their very paucity. The only other tradition of this character recorded in native text is the one I obtained detailing the life of the great Iroquois statesman, Deganawida, and his part in the founding of the League of the Iroquois.

In 1898 Mr. Seth Newhouse, then a Mohawk Chief, had completed the collection of a considerable amount of undigested material relating to the laws and structure of the League of the Iroquois, upon which he had earnestly worked without compensation more than 20 years. He had undertaken this arduous task, however, at the suggestion of the Council of the Six Nations of Ohsweken, Canada. In this undertaking Chief Newhouse, preeminently a master of his mother tongue, the Mohawk, made a most serious mistake by recording the

information he was collecting in very broken English. Consequently, many passages in his work were equivocal, while others conveyed a sense quite contrary to that intended. Furthermore, the material he collected was not arranged in an orderly manner according to topics. He had failed to grasp the fundamental principles of the structure of the Institution of the League of the Iroquois. Twice he submitted his compilation to the Six Nations Council for acceptance, but each time it was rejected. Another serious objection to the Newhouse collection arose from the fact that Chief Newhouse, quite unconsciously, it may be, frequently infused his own personal opinion into what purported to be historical tradition. Nevertheless, I persuaded Chief Newhouse to translate the material which he had collected into



FIG. 182.—Mr. and Mrs. Alexander Sherry with Miss Ruby Elliot, their granddaughter, Ohsweken, Canada. The Sherrys are both typical Tuscarora and the oldest persons living of this tribe.

the excellent Mohawk of which he was a perfect master, in order to preserve fine examples of Mohawk forensic diction which it was next to impossible to obtain otherwise.

So by a rigid comparison of this Mohawk translation with other kindred material in the Onondaga and the Cayuga dialects relating to the same aspects of the League, I sought to conserve in the Newhouse material what accorded with historical tradition and to eliminate what was due to the personal opinion of Newhouse. The residue then in its contents accords in a confirmatory manner with similar material obtained from the other dialects, and is embodied in excellent Mohawk.

With the assistance of Mr. Alexander Sherry and wife I was enabled to record a valuable list of Tuscarora proper names. This

aged couple are typical Tuscarora persons, for they both claim descent from grandparents who emigrated in the 18th century directly from North Carolina, the ancient home of the Tuscarora tribe. Mr. and Mrs. Sherry are both past 75 years of age.

At the village of Ohsweken, I visited the newly completed Lady Willingdon Hospital, where I was delighted to see four babies and their Iroquois mothers; the youngsters were all less than 24 hours old, and they and their mothers were receiving the best of hospital attention. This institution was built at the suggestion and under the patronage of Lady Willingdon, the gracious wife of the present Governor General of Canada. It was opened in 1928, and is fully equipped with the most modern appliances and appointments. It is an institu-



FIG. 183.—The Lady Willingdon Hospital at Ohsweken, Ontario, Canada. Completed in 1928.

tion that was much needed for both service and for instruction in the care and treatment of diseases among these people.

In the course of my work I purchased a ceremonial set of wampum strings of exceptional interest and value, the use of which is required in the delivery of the Requickenng Address (*Adoⁿdaks'hä'*) of the Council of Condolence and Installation of Federal Chiefs of the League of the Iroquois. This set consists of 15 items or rather parts, consisting of one or two cords of wampum, each about six inches in length, to correspond with the 15 themes or burdens of the Requickenng Address mentioned above. These token cords of wampum are strung with white and purple wampum in accordance with a fixed pattern, with the exception of the first and the tenth which are composed entirely of purple beads of wampum.

Each cord of this set of wampum bears its own specific designation which is derived from the name of the Theme or Burden of Hurts of Life of the Requickening Address, for which it is a token. In fixed order these designations are as follows: First Section: I. Tears or One's Eyes. II. One's Ears or Passes into the Body. III. One's Throat or Passes into the Body (= Spirit). Second Section of Requickening Addresses. IV. Within One's Breast. V. The Trail of Blood from the Death Mat. VI. The Thick Darkness of the Night of Grief. VII. One's Lost Sky. VIII. One's Loss of the Sun. IX. At the Mound of Upturned Clay,—the Grave. X. Twenty, the Cost,—*i. e.*, the Penalty for Homicide. XI. The Hearth of the Home, Where One Circles the Fire. XII. The Woman,—Our Mother.



FIG. 184.—Chief John Buck's home, a loghouse, and two of his children. Six Nations, Canada.

XIII. The Federal Chief, Ne' Royā'ne'r. XIV. The Mind's Loss of Reason. And XV. The Ever-Burning Signal Torch And the Short Cord of Wampum Out of the Aging Pouch of Skin.

It may be worthy of record here that the Ritual of the Requickening Address, like the other six save one, of the Council of Condolence and Installation, is composed of two Sections. I recall this fact here because I have been unable to find an Iroquois informant who can give the reason for this grouping of the contents of six Rituals into two sections and because I myself have not found so far a satisfactory explanation of this matter, although I have had this mysterious question to solve for many years.

I also made a final redraft of a translation of the text of the traditional biography of the great Iroquois statesman, Deganawida, in



FIG. 185.—Mrs. Sally Ann Chew, a typical New York
Tuscarora, Sanborn, N. Y.



FIG. 186.—Chief Emmet Lyons, an Onondaga, Onondaga
Reservation near Syracuse, N. Y.

which occurs the noteworthy Farewell Address of this chieftain to the Federal Council of the League when he resigned from it when he felt that he had completed his work.

The great difficulty encountered in attempting a translation of such a document lies in the fact that in large measure its words and phrases have either a forensic, a legal, or a ritualistic, denotation, which may be far removed from its sense in the daily speech of the people. An example of this figurative employment of ordinary words is the employment of the obsolescent term for mat in the sense of land or country, and qualified by other highly metaphorical terms. Given the expression, meaning the great white mat, one must discover its forensic meaning, a land covered with peace, a country covered with good health; also the use of the word meaning day for year, season, or time. It is almost impossible to find an Iroquois of today who can understand such metaphoric expressions, and even should they be understood, to render them into technical English terms is not possible because such English words are unused by them.

It may be of general interest to call attention to the fact that some of the Iroquois still dwell in log houses. An accompanying illustration of the home of Chief John Buck, Jr., shows the main outside features of such a building. Logs of suitable lengths are hewn into slab-like form, 8 or 10 inches thick and 14 to 20 inches broad. The ends of these timbers are cut in such wise that they will dovetail together and so interlocking as to form a firm and secure structure, which is usually two stories high. The timbers are laid one over another in such manner as to form four walls, and the interstices between them are filled with cement or clay mud so that winds and rains and snows do not enter the building. When in good condition they are very comfortable, much more so than the ancient elm bark structures which they displaced.

Upon leaving the Grand River Six Nations of Ontario, Canada, I visited the Tuscarora of New York State, dwelling near Sanborn, N. Y. There, with the aid of Mrs. Sally Ann Chew, a typical Tuscarora woman, I recorded in her language more than two hundred plant, animal, and bird names, and some personal names. Leaving this reservation I visited the Onondaga reservation near Syracuse, N. Y., where assistance was obtained from Chief Emmet Lyons on some moot points of translation and interpretation of Onondaga texts of the League of the Iroquois. Thence, I went to Rochester, N. Y., where I inspected the Iroquois collections in the Municipal Museum of the City of Rochester, which is under the capable Directorship of Dr. Arthur C. Parker, former State Archeologist at Albany, N. Y.

STUDIES OF THE ALGONQUIAN TRIBES OF IOWA AND OKLAHOMA

By TRUMAN MICHELSON,

Ethnologist, Bureau of American Ethnology

The Kickapoo and Arapaho tribes of Oklahoma, the Fox of Iowa, and the Sauk, Shawnee, and Cheyenne of Oklahoma formed the subjects of my field studies during the summer of 1929. Some weeks were first spent with the Kickapoo. When their history is borne in mind, with the dramatic flight to Mexico, the difficulties ensuing allotment with the attendant frauds, and so on, it is not to be wondered at that they are still remarkably tenacious of their ethnology, and very unwilling informants. In spite of these difficulties a really representative collection of Kickapoo mythology was obtained, mostly in the current syllabic script. Combined with the material previously collected by the late William Jones, edited and translated by myself, it is possible to make some very definite statements from a comparative point of view. The tentative statement I made 14 years ago (Pub. Amer. Ethnol. Soc. IX, p. 140) that Kickapoo mythology and folk-lore are on the whole closest to Fox, holds valid. It is barely possible that with a really representative collection of Sauk mythology and folk-lore this opinion might have to be somewhat modified; for the Sauk material, published and unpublished, is too meager to be seriously considered at present. It may be mentioned, however, that Kickapoo shares with Sauk the tale of the culture-hero and the "little frighteners" which occurs in more northern tribes, *e. g.*, the Ojibwa and Cree. This is either totally absent among the Foxes or is known to but a few members of that tribe. At any rate, despite my many visits among them, I have not encountered it. A tale that is found among more northern tribes practically from coast to coast, that of the girls who married the stars, also occurs among the Kickapoo, but apparently not among the Fox. The contest of the Thunderers and water-monsters ("plumed" serpents), in this case Underneath-Lynx, of course occurs (for the distribution of this theme, see my discussion in Bull. 95, Bur. Amer. Ethnol., pp. 54-56); the tale of the Thunderer who is taken captive closely resembles a similar episode among both the Sauk and Fox (it can not be too strongly emphasized that these two tribes, though legally consolidated, are distinct in language and general ethnology). It may also be noted that the "transformer" theme, so common in



FIG. 187.—The floods at Tama, Iowa, in August, 1929.



FIG. 188.—Fox powwow, August, 1929.

the northwest, though apparently absent among the Fox, occurs among the Kickapoo. The rough character of the Mexican country is accounted for by ascribing it to the wanderings of the culture-hero (WĭΘA'kä'A). How the Kickapoo received, or adapted, the obviously modern myth that zebras come from underneath the water is unknown to me.

The religious ideas and practices hold their own with great vigor. Producing rain by dipping a garfish (of a sacred pack) in water is firmly believed in; this was tried with success in Sonora in 1915. What a triumph for Kickapoo fundamentalists! Causing sickness and death by "soul-stealing" is said to be still practiced. Details of the formal rituals appurtenant to the various gentes are still unknown, though it is clear that they resemble Fox counterparts. Kickapoo differentiate such offenses as will bring supernatural punishment and such as will bring human punishment; the former we would term "sins"; the latter "torts" (rarely "crimes"). Some offenses fall under both categories. To this extent are ethics and religion associated among the Kickapoo. Offenses are graded: it is worse to desecrate a sacred pack than it is to steal; murder is worse than desecrating a sacred pack. In this connection it may be noted that the Kickapoo claim they obtained the obscene songs which are frequently sung during the moccasin game when ladies are not present, from the Sauk and Fox. A few years ago a Fox visitor ventured to sing these objectionable songs, in accordance with the custom of his own tribe, in the presence of Kickapoo ladies; the latter were indignant, but let it go as he was a visitor. A point in Kickapoo sociology may be here mentioned: it is claimed that two boys who have the same father but a different mother are more closely related than two boys who have the same mother but a different father. The Kickapoo language is an archaic Algonquian one, despite some secondary changes.

Work among the Sauk and Shawnee was chiefly linguistic. The new data clearly show that Shawnee is further removed from Sauk, Fox, and Kickapoo than supposed, though it is abundantly clear that it is closer to them than to any other central Algonquian language.

Only a short time was given to Cheyenne, and practically only linguistics were considered. The phonetics of the language are difficult, voiceless syllables in particular being difficult to record accurately. The opinion that I gave years ago that Cheyenne must be considered aberrant Algonquian is fully sustained. It had been long known that Cheyenne was Algonquian. Some phonetic shifts were worked out. It is obvious that a detailed study of the language would be well worth while. Some social customs were noted, among them, male descent.

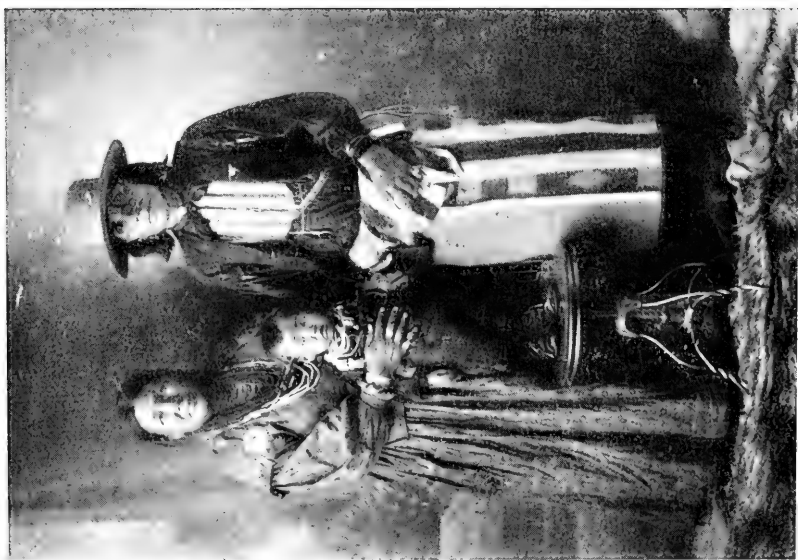


FIG. 190.—Mexican Kickapoos.



FIG. 189.—Fox dancer.

The work among the Arapaho was likewise mainly linguistic. It will be recalled that, as I have said previously, Arapaho is divergent Algonquian. Complex phonetic shifts abound, and it was pos-



FIG. 191.—Pushetonequa, the last Fox chief recognized by the Federal Government.

sible to work out some more of these. Up to the present time it has been the phonetic shifts and lack of some common Algonquian grammatical features, rather than the presence of un-Algonquian grammatical ones that have forced the designation of Arapaho as divergent Algonquian. This summer it was possible to definitely show at least

one fundamentally un-Algonquian grammatical trait, namely, the insertion of the syllable *-en-* after the initial consonant of a primary verbal stem to express habitual action. So far as known this trait is unique. It is therefore not possible to state whether this is self evolved, or borrowed from some outside source. The theoretical importance of this is very great. It is perfectly well known that a purely genealogical grouping of American Indian languages breaks down; it is only a question as to on how great a scale the borrowing of grammatical features can occur.

The work among the Fox of Iowa consisted largely of restoring phonetically texts gathered previously in the current syllabic script, obtaining translations, etc. I returned to Washington August 31, '29.

In conclusion I should add I am more than ever convinced that all members of primitive societies are not alike; differences fully as great as in our own society occur; even so-called intellectual classes exist among them. Nor is the opinion tenable that every one in primitive society is as free as the air: all primitive societies have restraints and obligations fully as strict as our own. Nor do the ethical ideals of primitive peoples differ fundamentally from our own; the content alone is different. Nor are natives any more "pre-logical" than we are. Given, say, the belief in Thunder-birds, any Indian of the Great Plains can justify this fully as acutely as we can justify some of our own beliefs. Nor are natives (as Herbert Spencer fondly imagined) explosive and incapable of self restraint: they can and do restrain themselves on occasions where we should not, and vice versa. Similarly they have their own etiquette, whether this coincides with ours or not.

STUDIES AMONG THE CHOCTAW OF MISSISSIPPI AND THE CREEKS OF OKLAHOMA

By JOHN R. SWANTON,

Ethnologist, Bureau of American Ethnology

In the neighborhood of Philadelphia, Mississippi, live the descendants of those Choctaw who chose to remain in their ancient territories after the treaty of Dancing Rabbit instead of moving into the lands intended for them in what is now southeastern Oklahoma. Today they number about 1,200 in spite of several later emigrations, and among them are to be found the most conservative of the nation, because forced emigration after white contact always tends to destroy the continuity of the tribal tradition and paves the way for the disruption of the old order. The first two weeks of my 1929 field-work were devoted to interviewing a few of those old Choctaw Indians who still remember the ancient customs of the tribe. With the information, thus obtained, I corrected and amplified notes made during a previous visit.

I took the opportunity also to revisit the famous hill of Nanih Waiya, out of which according to certain native legends the Choctaw originally came. A cave within a short distance of this mound may have played some part in localizing the myth of origins there, and the resemblance between the names Nanih Waiya, "Bending Hill," and Nanih Waya, "Hill Bringing Forth," may also have contributed to this identification. As a matter of fact the hill is artificial and at one time probably carried the communal buildings of some Indian town. It was surrounded by a stockade, traces of which are still to be seen. Nanih Waiya has been mentioned before in the Smithsonian annual exploration pamphlets, both by myself and by Mr. Henry B. Collins, Jr., and views of it may be seen in the pamphlet for 1918 and that for 1925. My work at Philadelphia was furthered in every way by the Agent for the Eastern Choctaw, Dr. Robert A. Enochs, to whom I am particularly indebted.

After leaving Philadelphia, I spent a few days in Jackson, Miss., consulting manuscripts in the Department of Archives and History at the State Capitol, where, as on former occasions, I was most hospitably entertained by the Custodian of the Archives and State Historian, Dr. Dunbar Rowland.



FIG. 192.—Nanih Waiya, the sacred hill of the Choctaw Indians, viewed from the northwest. According to certain of their legends the ancestors of the tribe came out from beneath the earth at this spot. The mound is artificial and evidently bore the communal or ceremonial buildings of some town.



FIG. 193.—Beginning of the Women's Dance at the Square Ground of the Okchai band of Creeks near Hanna, Oklahoma, taken from the cabin or arbor of the chiefs on the west side of the square.



FIG. 194.—Ceremonial ground of the Nuyaka Indians, a branch of the Okfuskee band of Creeks who have adopted the name of the American metropolis. The picture was taken from the southwest and shows the ball-post to the right and the four arbors or cabins of the Square Ground to the left.

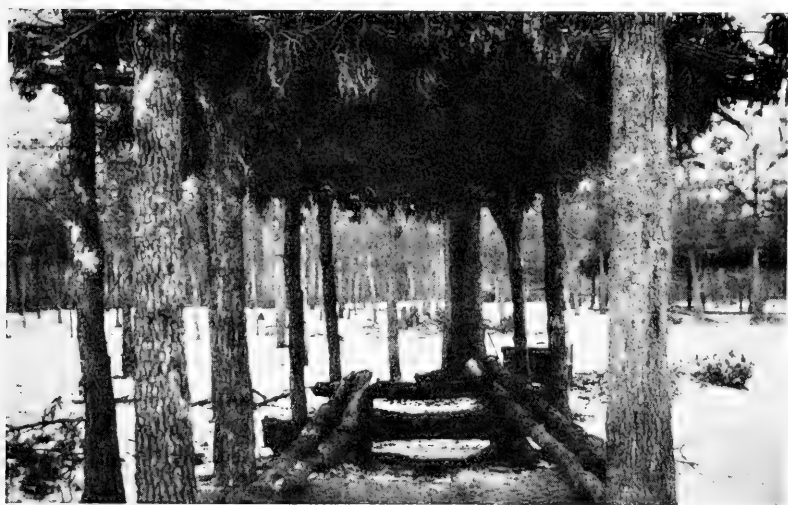


FIG. 195.—The western or chiefs' arbor of a Square Ground near Hanna, Oklahoma, formerly used by the Hilibi band of Creek Indians. The picture, taken in midwinter, shows the method of construction.

From Jackson I went to Oklahoma, where my time was spent entirely among the Creeks, and was devoted to the task of obtaining data on the extant Creek Square Grounds, particularly the manner in which the various clans, classes, and officers were seated in the cabins or "beds" which composed each Square. In pursuance of this work I visited about half of the Creek ceremonial grounds proper and was present during a part of the annual ceremonies or "fasts" at three of them. Unlike the Choctaw, the Creeks had evolved before white contact a series of communal ceremonials held at certain sacred grounds (the Squares) which were the common property of the several subdivisions of the Creek Nation. Before these Indians were removed to Oklahoma there must have been 50 or more Squares but they have now been reduced to 17, not including three maintained by the incorporated Yuchi tribe.

One of the Lower Creek Squares, Kasihta, has recently been revived. It is evident that the racial and cultural pressure of the whites has stimulated renewed interest in the ceremonies as symbols of that culture to which the Creeks had independently attained. They are so many outward expressions of the "defence mechanism" of the people, efforts to retain their racial and cultural self-respect in the midst of the levelling tendencies of the alien civilization which surrounds them. This fact should be kept in mind by those to whom such ceremonies appear barbarous and valueless. At the same time the extent to which Indian life has elected to adapt itself to the new cultural invasion is interestingly illustrated at their annual ceremonies, which the aborigines now attend in their automobiles, only a very small percentage of which are "flivvers." When the ceremonies are in full swing, the Square Ground is usually surrounded by a complete fringe of cars and the harangues of the speakers—in the native language and by intention at least in the native style—are frequently punctuated by the more familiar sounds of cars just starting up or coming to rest. At night, when dancers get too far away from the central fire to be observed clearly by the crowd, obliging native chauffeurs improvise a stage illumination by turning on their headlights. Altogether these occasions form an interesting picture of the clashing racial and cultural streams which have given rise to them and of the still more profound human motives by which they are interpenetrated.

TRIBAL CUSTOMS OF THE MENOMINEE INDIANS OF WISCONSIN

By FRANCES DENSMORE,

Collaborator, Bureau of American Ethnology

The Menominee reservation, with its beautiful forests of pine and rushing rivers, is located north of Shawano, Wisconsin. Here during the summer of 1929 I continued my study of Indian music for the Bureau of American Ethnology among the Menominee Indians. The particular purpose of this season's work was to obtain additional information which would supplement the songs and other material collected on two previous trips, and to obtain the correct form of proper names and words pertaining to music.

The old men and women of the tribe were again questioned, several new informants were found, and a large gathering of Indians was attended. At this gathering I witnessed the women's games of "dice and bowl" and "double ball." The first name is said to have been given to the Menominee by the spirit women who live in the eastern sky, and the songs of its origin had already been recorded. The game may be played as a pastime but is primarily a means of securing personal benefits promised by the spirit women in a dream. The action consists in tossing upward a shallow bowl containing disks made of bone, and the score is counted by the exposed surfaces (fig. 198). I obtained a set of the game implements, which comprise eight round disks, one flat disk representing the common turtle and one representing the head of the great "spirit turtle."

The double ball game is played by several women on an open field, each player holding a stick with which she tosses a pair of leather pouches, commonly called balls. The players are divided into two opposing sides, each seeking to toss the pouches across the other's goal.

This gathering was held at the native village of Zoar and the dances took place in the arbor-like lodge where I witnessed the Drum Presentation ceremony in 1928. The drum (fig. 197) was suspended on shorter stakes than those supporting the ceremonial drum, and beneath it was a bowl-shaped hollow a few inches in depth. Thus the earth served as a resonator for the drum. The singers were seated around this drum, according to the Indian custom.

The principal informant was Mitchell Beaupre (fig. 199), whose Menominee name is Mowa'sa, commonly but inadequately translated



FIG. 196.—Dense pine woods on Menominee reservation, where Miss Densmore recorded old customs of the tribe. (Photograph by W. H. Wessa, Antigo, Wis.)



FIG. 197.—Drum used by Menominee at social dances. (Photograph by Miss Densmore.)

Little Wolf. His father was a French trader and his mother a full-blood Menominee. At the age of 83 he is still a close observer of tribal customs as well as an intelligent student of the old beliefs.



FIG. 198.—Woman playing dice and bowl game. (Photograph by Miss Densmore.)

Many subjects were discussed with him, including the performances of the medicine men, the native treatment of surgical cases, the making and keeping of a hunting bundle, the connection of the Thunders with the lacrosse game, the briefs concerning the "underwater people," the legend of the first death (by drowning), and the first jour-

ney to the land of spirits. To all these, and to the descriptions of the Medicine Lodge, he gave the best of his knowledge and experience.

David Amab', a singer and informant of former years, was near to death from cancer but was able to answer a few questions and to impart certain information which he "had on his mind," hoping that I would return to receive it. He died ten days after I left the reservation.

Valuable information was also received from Rattlesnake, a leader in the "drum religion," and from Henry Valentine Satterlee, who acted as my interpreter in 1925 and is a recognized authority on the Menominee.

The principal subject of inquiry on this trip was the manner of treating the sick, both by herbs and by means of the "juggler's tipi" or divination lodge. This structure resembled an ordinary tipi but was smaller in diameter. The medicine man, or juggler, was tied with thongs and placed in this tipi, which he then caused to shake as though in a tempest. He summoned the spirits, who talked with him, revealing the cause of the patient's illness and the manner of his cure. If the person was being "bewitched" he called the evil spirits into the tipi, where he wrestled with them and conquered them, after which he assured the sufferer that no further difficulty need be anticipated. Friends of the sick person, seated outside the tipi, heard the "voices of the spirits," but only the juggler could understand them. Different spirits had different voices, for example the mud turtle gave a whinnying sound. Mitchell Beaupre said he had heard that the juggler held in his mouth something with which he produced the sound, but was not certain about it. Several informants stated that the poles of this structure were pointed, but from David Amab' it was learned that the poles were blunt at the lower end. A heavy pointed pole was used in making the holes in which the permanent poles were placed, giving the impression that the frame of the tipi was of pointed poles. The swaying and bending of the tipi could be more easily accomplished with blunt poles, moving in sockets. These observations do not, however, deny the hypnotic phase of a juggler's demonstration.

Information concerning the Menominee use of herbs in treating the sick was obtained from Mrs. Harriet Longley of Keshena, whose mother, known as Sophie Pete'ta, was a prominent medicine woman of the tribe. Her mother's Menominee name was Nata'wika, meaning "the whip-poor-will finds a place and dances" (fig. 200). Mrs. Longley learned the use of herbs from her mother but makes no practical use of that knowledge. She gathered for me 58 specimens of medicinal plants and trees, representing a wide variety of environ-



FIG. 199.—Menominee informant, Mitchell Beaupre. His Menominee name is Mowa'sa, inadequately translated Little Wolf.

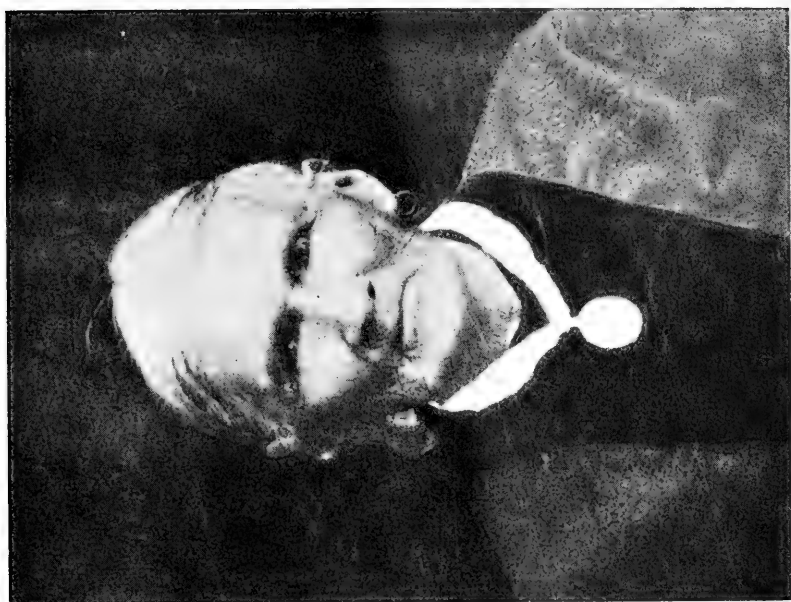


FIG. 200.—Nata'wika, Menominee medicine woman.

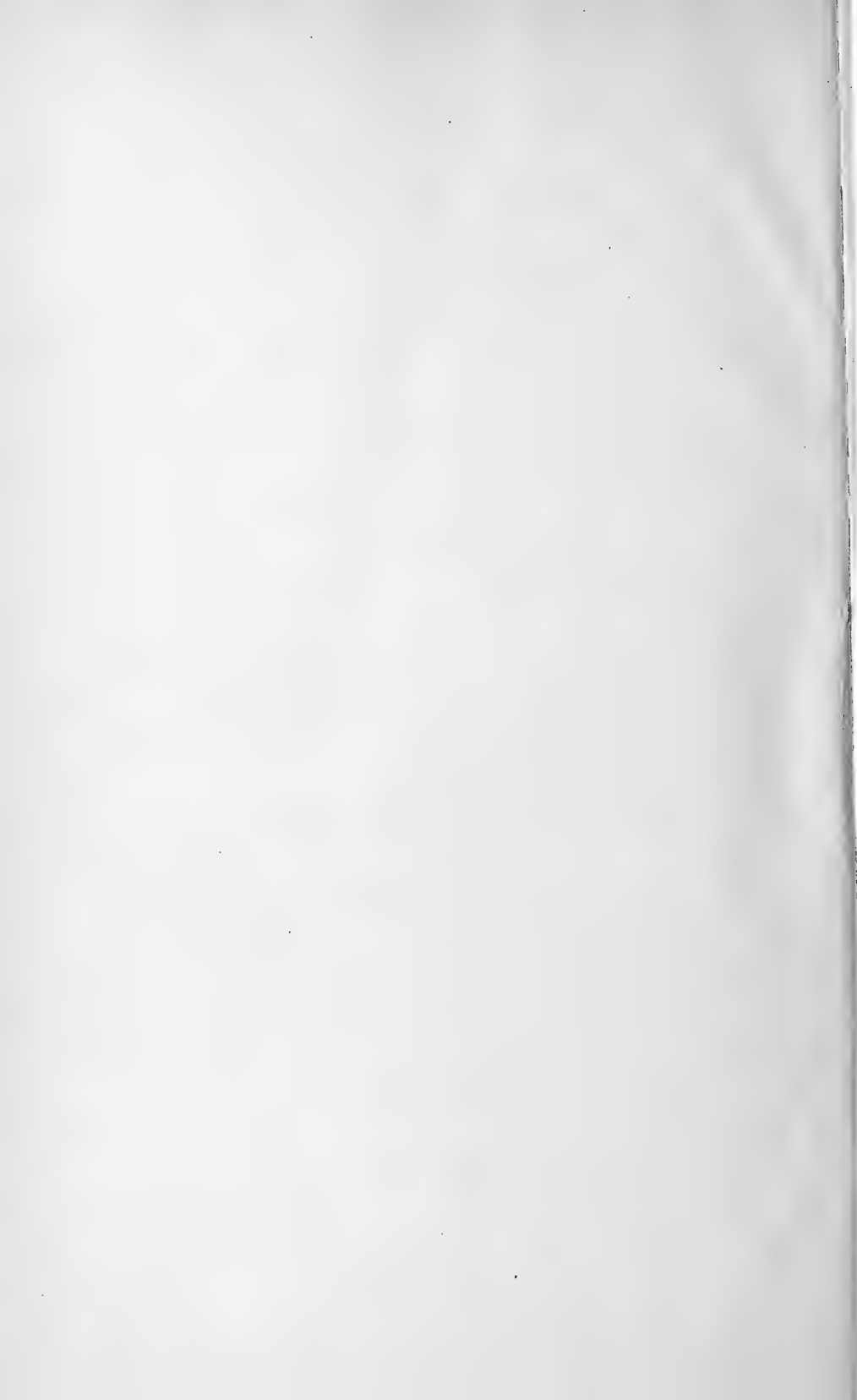
ment. I accompanied her on four expeditions, two into the woods, one to a lake and one to the high, burned-over land in the northern part of the reservation. Tobacco was provided, which she placed in the ground according to the old custom, speaking the words her mother used.

In order that all the requirements of the old custom be met, I presented her also with food and a gift. The plants were identified at the U. S. National Herbarium, chiefly by Mr. E. C. Leonard. On comparing these with the list of plants used by the Chippewa, it was found that many plants occurring on both lists were used differently in the two tribes. There is no standard pharmacopoeia among the Indians, each doctor using herbs according to his own dream or that of the man from whom he obtained his instructions. The horn used by Nata'wika in cupping the temples of those afflicted with headache was obtained; also a specimen of medicine prepared by her, consisting of mixed herbs tied in a cloth. The song which she received in her dream and sang when gathering her medicine was sung for me by her daughter. Nata'wika died in 1918 at the age of more than 80 years, and is still honored throughout the reservation as a woman whose whole aim in life was to help the sick and suffering members of the tribe.

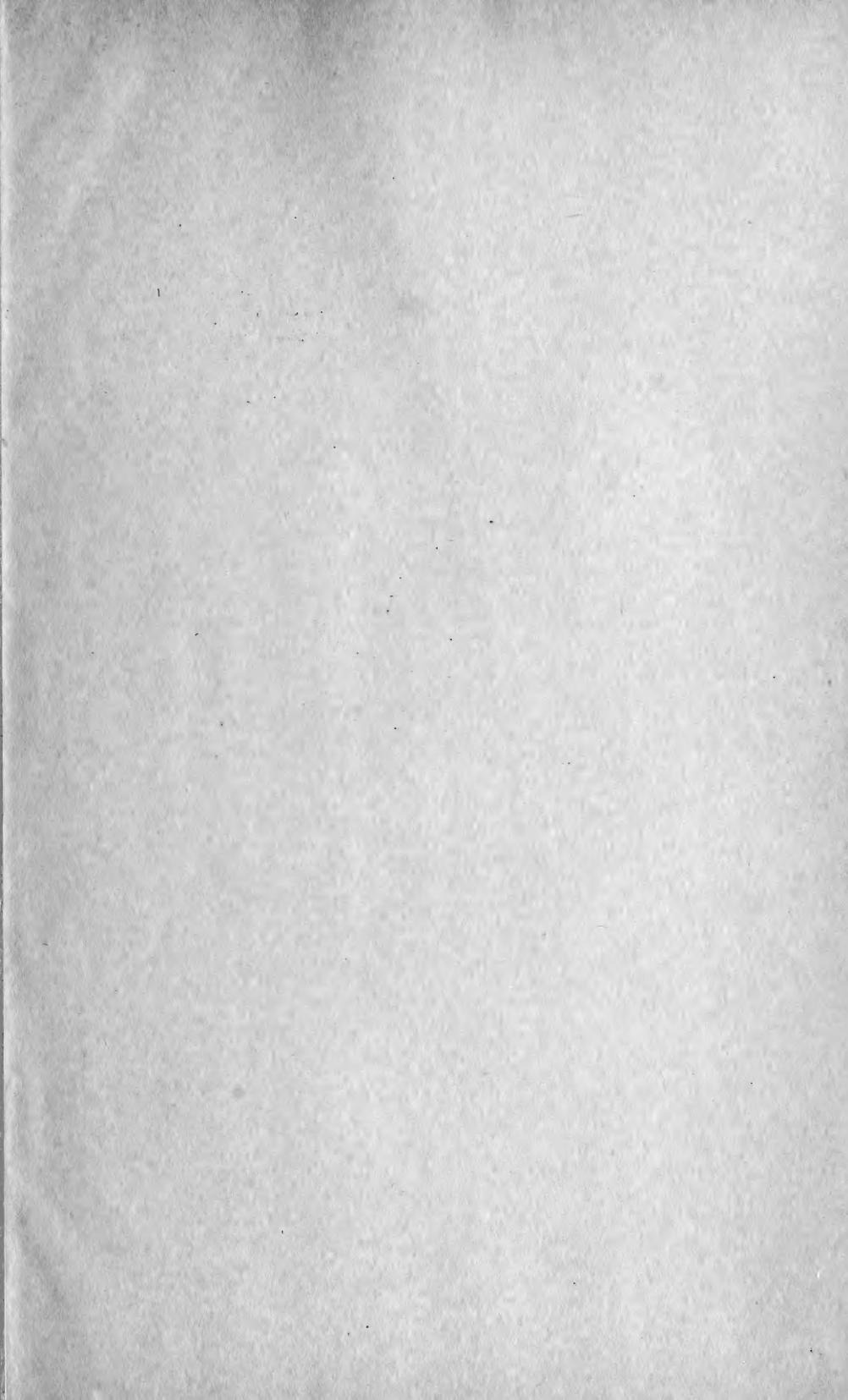
The correct spelling of Menominee names and words was provided by Frank S. Gauthier, a prominent member of the tribe whose father, Joseph G. Gauthier, was interpreter for the Menominee for 30 years.

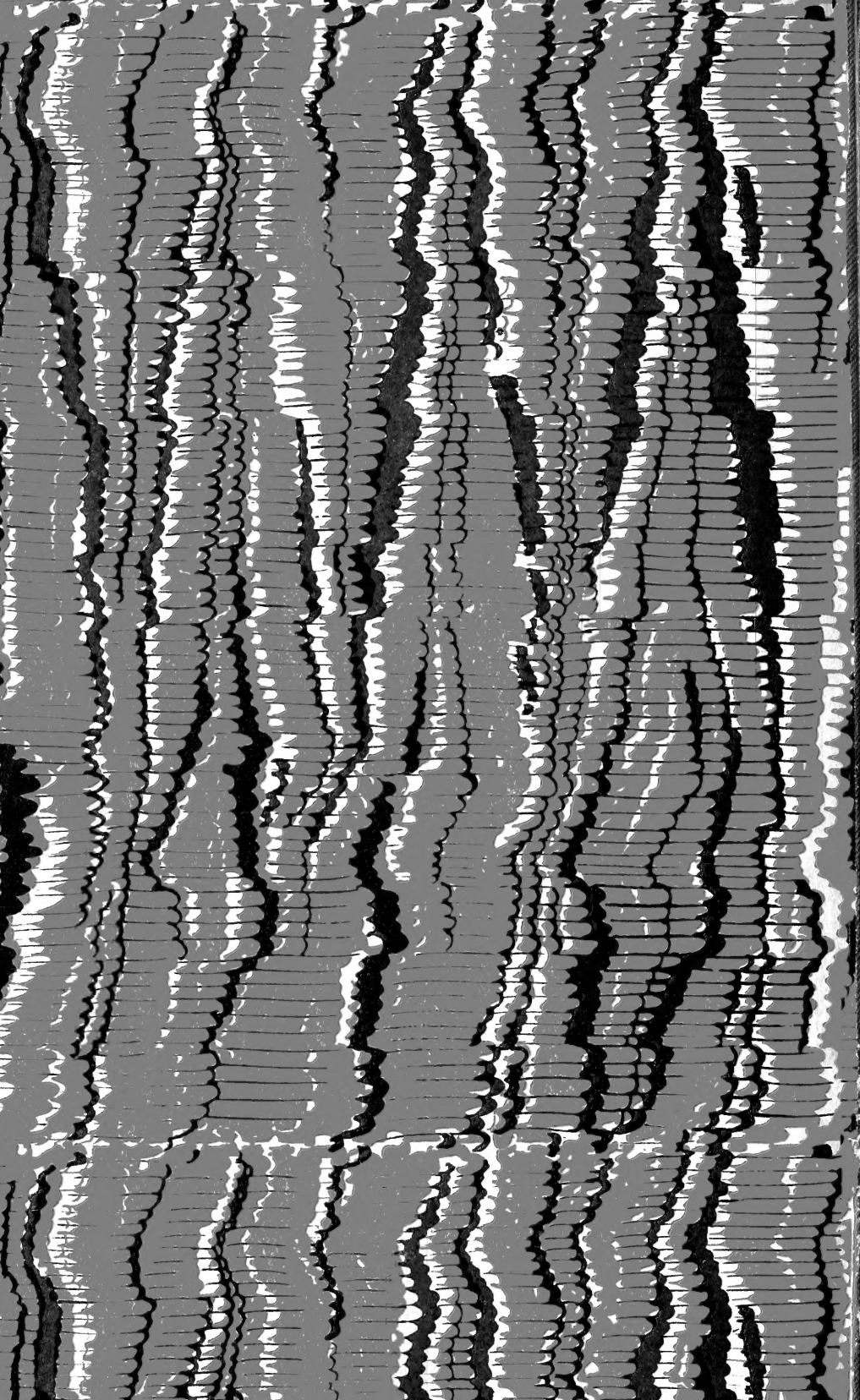
After leaving the Menominee reservation I visited the Winnebago south of Galesville, Wisconsin, securing valuable information pertaining to the study of their music. These Indians belong to the Thunder clan, and many of their songs had already been recorded. The making of baskets from black ash has been commercialized by the Winnebago, who claim that the instructions for the work were received by a woman in a dream. The Thunder clan have one of the largest basket-making camps in western Wisconsin, and yet hold to the old beliefs and customs.

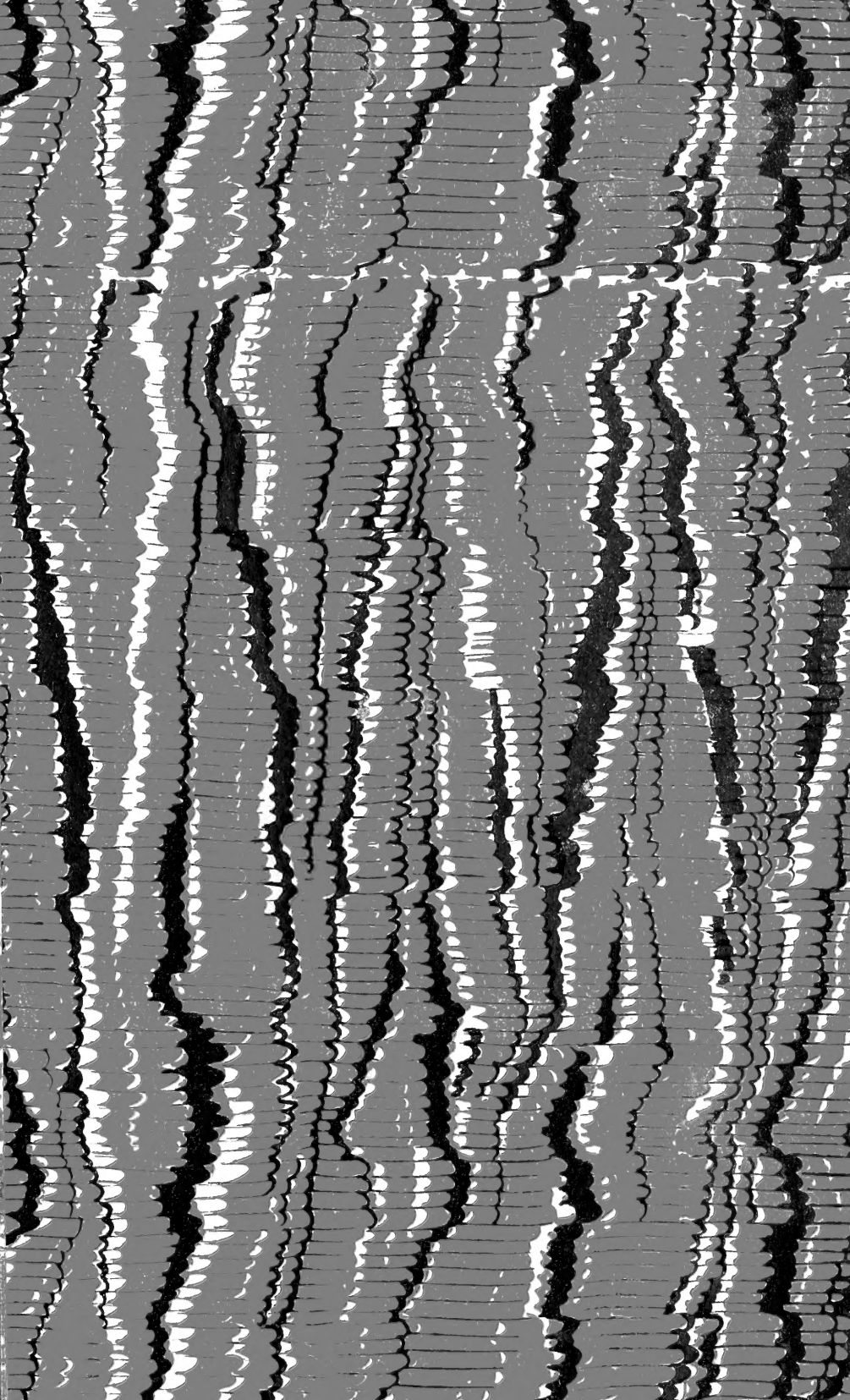












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